FLIGHT, FEBRUARY 25, 1937 FIRST AERO WEEKLY IN THE WORLD REGD. AT THE G.P.O. AS A NEWSPAPER

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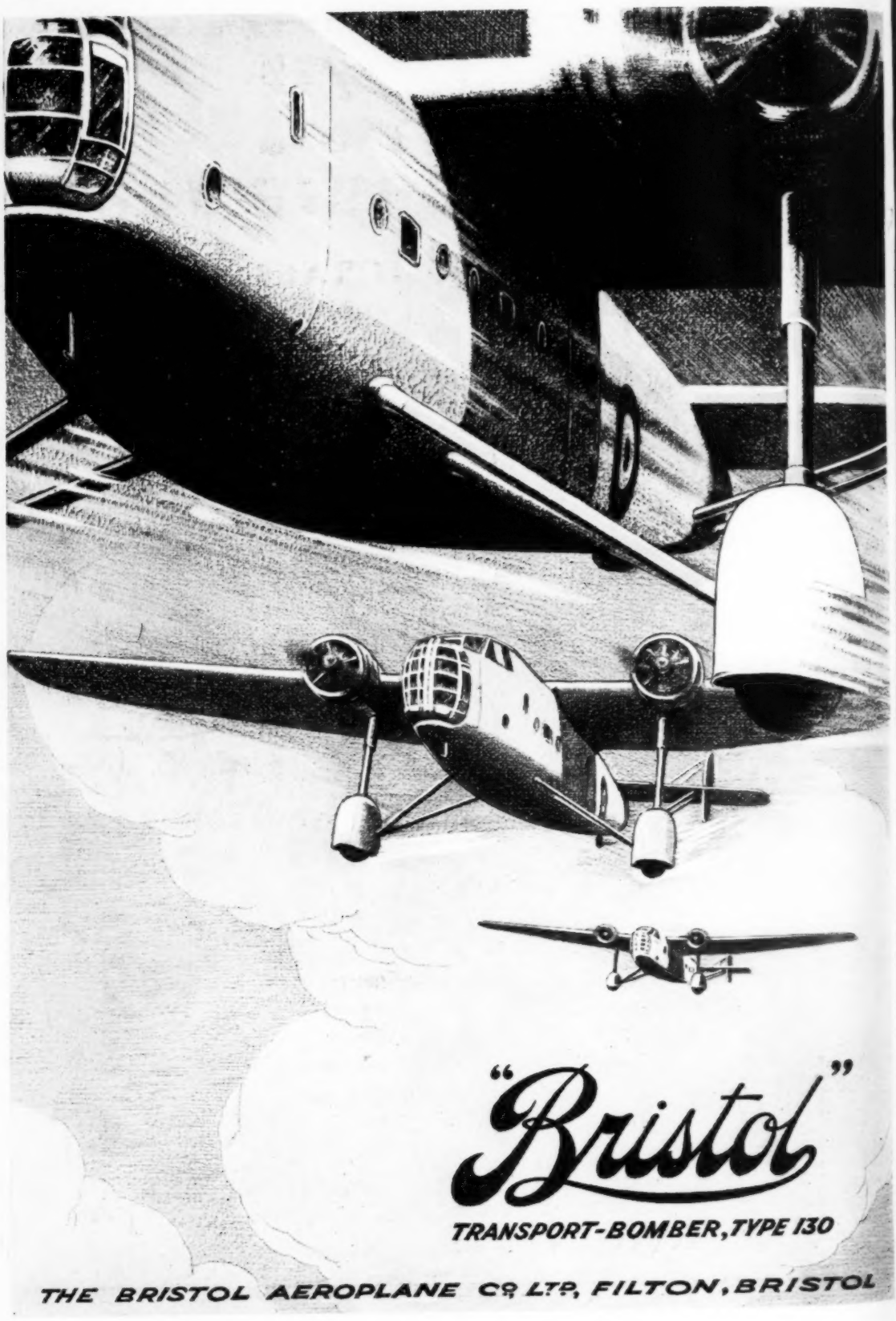
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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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Flying-boat Prestige

THE recent flights by two British flying boats have done much to show the world that the lead which Great Britain held some years ago in this particular type of aircraft is being re-established. One need not look back very many years for a time when it was something of an adventure for an aircraft to complete a "Circuit of Britain." Yet last Sunday the *Cambria* covered that route non-stop during daylight at a very comfortable amble of 135 m.p.h. with her engines at half-throttle, being mainly concerned with trying out her radio, and having plenty of time to circle towns en route to give people an opportunity to see her.

For a good many years the R.A.F. sighed for a flying boat which would do the voyage between England and Gibraltar non-stop. The flight *has* been made, but with no comfortable margin. Then, on Thursday of last week, the *Caledonia* startled the world by covering the 2,500 miles between Calshot and Alexandria non-stop at an average speed of about 170 m.p.h. The R.A.F. can now have, whenever the Air Council decides to ask for them, as many boats as they like, easily capable of reaching not merely Gibraltar but Malta without intermediate landings, while still carrying quite a substantial military load, and even Egypt can be reached without asking anyone's permission to alight for refuelling. The progress which these two flights denote, and their significance, is there for everyone to see; and at Bermuda the *Cavalier* has made a flight around the islands, so that "luck" is not likely to have played any considerable part in this recent contribution to British flying-boat prestige.

Of course, *Caledonia* and *Cambria* are not "airliners" like *Canopus*, *Centaurus*, and the rest of them. Yet it would not be fair to call them "flying petrol tanks," for each could have carried a reasonable payload in addition to her petrol.

There is no doubt that these two boats can fly the Atlantic against any normal headwind, and on the eastward journey they should do fast time. But it must be borne in mind that they are not intended for commercial use across that ocean. They are merely test machines for the accumulation of data about Atlantic operation. From the information which they provide, other boats will be designed for the actual commercial work. They will probably be still larger and still faster than the "C" class boats, more economical to run, and so giving a better chance of dividends from reasonable fare and mail charges.

Something to Think About

OF the many instructive and informative papers read before the Royal Aeronautical Society during recent months, none has been more crammed with useful information, nor so provocative of hard thinking, as that delivered by Mr. Fedden last Thursday. It was a model of what such a lecture should be, and deserved a better discussion. A correspondent elsewhere in this issue takes the British aircraft industry severely to task for not contributing more usefully to the verbal exchange of views. While doubtless many will send in their remarks in writing, to be printed in the Society's *Journal*, and while we do not subscribe to everything our correspondent writes, there is no denying the fact that the remarks made during the discussion did not do justice to the lecture. To some small extent this may have been due to the absence from the printed paper of any of the twenty-odd illustrations thrown on the screen. Graphs and tables cannot be "digested" in a few seconds, and had these illustrations been included in the printed paper, members of the audience

would have had a better chance to form their opinions.

As for the paper itself, its importance is such that we have decided upon the somewhat unusual course of devoting almost the whole of *The Aircraft Engineer* supplement to it this week in the belief that readers all over the world will welcome the earliest possible information on a number of subjects which are bound to have a profound effect on the immediate future of aviation development. One may or may not agree with everything Mr. Fedden said, but it is impossible either way not to be intensely interested.

At the Cross Roads

The present time is a critical one, and upon the decisions made in the near future will very largely depend the lines upon which British aviation is to develop during Mr. Fedden's "Five-year period." One thing seems certain: it is time that the needs of civil and military aviation are studied separately. Gone are the days of the general-purpose engine; specialisation is the order of the day, and will tend to become more and more so. Moreover, the "thoroughbreds" now being developed will require a longer development period than did the general-purpose engines of a few years ago, and it must be assumed as a logical corollary that periods between the introduction of new engine types will tend to increase. This will make it doubly necessary to study each project thoroughly before putting it into production.

One aspect which was brought into prominence by the lecture and the discussion was the growing uneasiness concerning the way in which Great Britain is allowing the diesel engine to drop into the background. The C.I. engine received support from many quarters, some of them rather unexpected. Even in the sphere of military aviation there seems to be room for the diesel (for long-range aircraft) in spite of the almost phenomenally low fuel consumptions which are expected from 100-octane petrol. In civil aviation the claim of the diesel is far greater. Fire is but one of the many risks which the crew of a miliary aircraft have to face. That risk is likely to be considerably increased if 100-octane fuels are introduced, owing to the hotter engine and the closer cowlings that will be used. For a time at least, the civil market is not likely to be large enough to produce special civil petrol engines, and the insistent call for increased performance may result in 100-octane military engines being introduced in civil aircraft if no alternative is available.

The diesel engine does appear to be useful both in military and civil aircraft of certain types, and therefore it is logical to argue that it should be developed. It begins to look as if the "assisted" type of take-off will come in for careful examination in the near future, be it of the "composite aircraft" type, catapult-launched or some other form. The great—in fact, one might probably say the greatest—drawback of the diesel is that for a given size it will not give as high as specific output for take-off as will the petrol engine, although it can be cruised at something nearer its maximum power. The assisted take-off may reduce this disability and may well result in making the diesel a good deal more attractive. It is hardly to be expected that private enterprise will be willing to find the necessary capital, and some form of Government support seems inevitable.

BASKING SHARKS: Egyptian sunlight lends a particular charm to this view of Blackburn Shark T.S.R.s (Siddeley Tiger VI engine) from H.M.S. *Courageous* over Aboukir, the coastal town and R.A.F. base near Alexandria.

The Outlook

A Running Commentary on Air Topics

The Knight's Move

IT is not yet proved that because flying boats can be built which will cross the Atlantic with a margin of fuel in their tanks it will follow that the payload will be able to pay a dividend. If fares and rates have to be very high, that will check bookings. We must wait and see. Even if the Atlantic service should only be able to deal profitably with mails, the development work which has produced *Caledonia* will not have been wasted. In the past our air communications have been hampered by political difficulties, and we have had to recognise that it was in the power of an unfriendly foreign nation to prevent our aircraft, civil or Service, from flying direct to the British possessions in the Mediterranean.

Now that has all been altered. *Caledonia* can cross the intervening countries as easily as a knight at chess can leap over the ranks of opposing pawns. As suggested in our leading article, Gibraltar can be reached by air as easily as Belfast can be reached by land and sea from London. Malta was not long ago only just within air reach of Gibraltar, but now it is possible to fly direct there from Southampton. In the future the most important of all British possessions in the Mediterranean will perhaps be Cyprus. It is now undeveloped, but will presently be a Naval and Air Force station. Trade will, as usual, follow the flag, and that great island will almost certainly become a Mecca to British tourists who hanker for the sun of the Mediterranean but want to see the Union Jack flying overhead. Such flights will not normally be made non-stop, but it is satisfactory to feel that they can be so made when good cause is shown.

. . . Most of the Game

CAPTAIN NORMAN MACMILLAN has returned from an air tour of Germany and Italy rather impressed by much of what he saw there. His third article appears this week and deals largely with his impressions of German aircraft production at the Henschel works. A well-known American pilot, Major Alford J. Williams, has also toured Europe, and on his return to America he has written his impressions for the Scripps-Howard newspapers. According to *U.S. Air Services* Al (as he is universally known) believes that one plant he visited could turn out fifty complete diesel engines every twenty-four hours under pressure and that another factory now producing three complete bombers every twenty-four hours could manufacture twenty a day by slightly expanding the present production method.

Italy can produce under pressure, in Al's opinion, as quoted by the same journal, about 2,000 complete fighter and bomber aeroplanes per month. The Caproni works employ 40,000 workmen and the Fiat 65,000.

After these somewhat astronomical figures Al's opinion of Great Britain's effort is not so hot. He can't say enough in praise of the fighters (pursuit ships, he calls them, of course) and engines he saw in this country, but maintains that mass production is our problem. "As far as performance is concerned," says Al, "British engines for high-speed single-seater and two-seater fighters, and the airplanes themselves, are superior to those of any other nation."

It is Al's estimate that we are turning out 500 to 600 engines a month, with an aeroplane production total of about 125 finished aircraft every thirty days. Under pressure, Al says, we could step up engine production to about 1,700 engines a month. How we shall be able to build a sufficient number of aeroplanes to use these engines is too much for Al to solve.

Well, well, Al, don't let that worry you. Quite a few people in this country are scratching their heads over that very thing.

Two-speed Blowers

SO far as is known a British firm can take the credit for being the first in production with an aero engine using a two-speed supercharger. Armstrong Siddeley Motors, Ltd. have announced that they are in production with the Tiger VIII and that its official ratings are 845 h.p. at 6,250 ft., with the blower in low gear, and 760 h.p. at 12,750 ft. in high gear, the take-off output being 920 h.p. The Tiger IX medium-supercharged unit in large-scale production for civil and military purposes is basically the same engine but gives only 880 h.p. for take-off, its rated output being 790 h.p. at 6,500 ft., so the advantages conferred by the new two-speed gear are obvious. A Panther also designated the Mk. VIII has been developed on similar lines.

Bristols have the Pegasus XVII and XVIII with two-speed blower gear, Wrights are experimenting with special versions of the Cyclone G believed similarly equipped, and Gnome Rhônes are offering their 14N, 14M and 18L models also with two-speed superchargers.

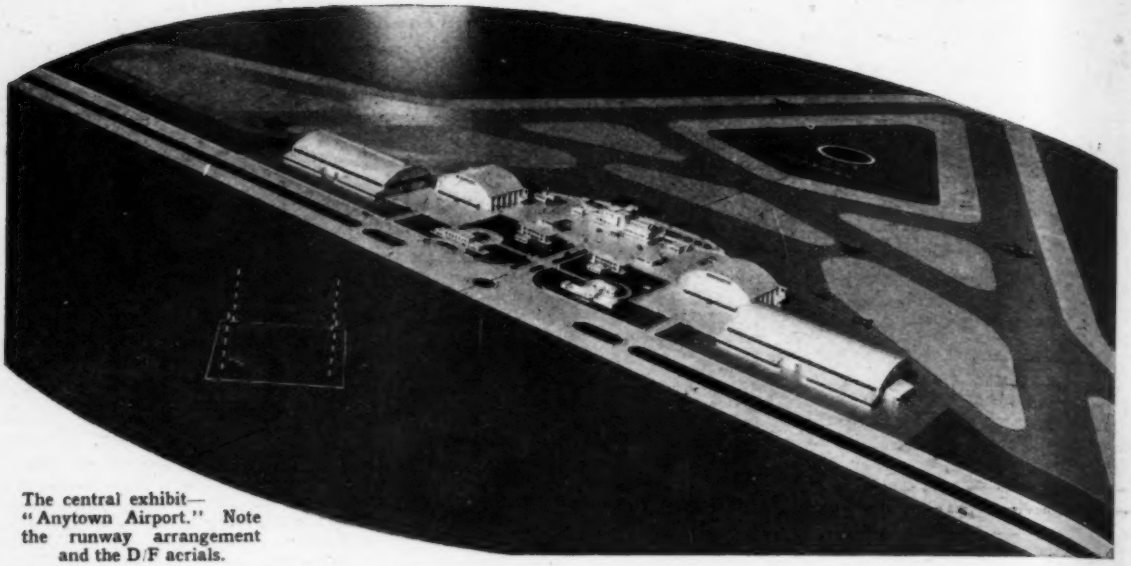
A 1933 Prophecy

PARTICULARLY interesting in view of the summary of Mr. Fedden's latest paper given in this issue are his prophetic words in 1933: "When it becomes necessary to restore the ground-level power of aircraft engines, at a greater altitude than has been accomplished at present, approximately 15,000 ft., still maintaining reasonable take-off power, I suggest the two-speed centrifugal blower offers the most practical solution, and I think there is no doubt that we shall see considerable development in this direction during the next few years. It is debatable if the weight and the complication of the two-speed blower are justified unless the rated altitude is raised in excess of 15,000 ft. . . ."

Though he forecast the development of the two-speed gear, his estimate of the minimum rated altitude for which its adoption would be justified is on the high side in view of the figures for the new Siddeley.

Bouquet from New York

OF recent years our American cousins, thanks largely to the help of their Russian designer, Sikorsky, have shot ahead of the world in the development of flying boats, but even they are becoming impressed by the programme which Imperial Airways have adopted, and by the craft built and building to carry out that programme. We cannot help feeling flattered when a writer in *Aviation*, the New York journal, speaks with glowing admiration of "Eighteen-ton flying boats slipping off the assembly line like Taylor Cubs; four-engined super-speed land transports 'almost ready for tests' months before our corresponding D.C.4 project even promises to be off the drafting table; real action toward a service across the Atlantic. . . . Call it long-nurtured strategy or a triumph of 'muddling through' as you prefer, Imperial Airways' program for the immediate future, if carried out as announced, can scarcely fail to give Great Britain a position in air transport equalling her leadership in ocean commerce."



The central exhibit—"Anytown Airport." Note the runway arrangement and the D/F aerials.

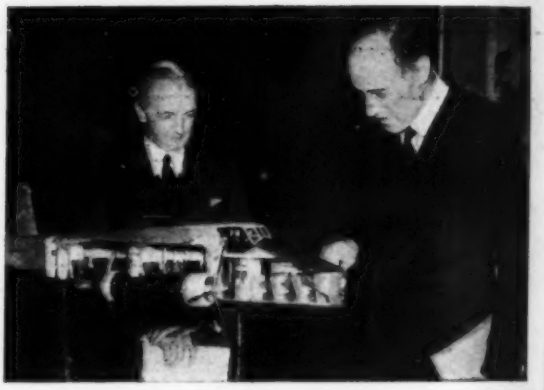
ARCHITECTURAL INTEREST

The R.I.B.A. Airports and Airways Exhibition Opened : To Tour the Country.

AT the official opening of the Airports and Airways Exhibition at the Royal Institute of British Architects last Friday several interesting points were made and expressions used by the three speakers. These, to some extent, explained the object of this exhibition, which will, in due course, appear in various centres throughout the country. (See *Flight* of February 18, 1937.)

The president of the Institute, Mr. P. E. Thomas, in introducing Lord Swinton, who opened the exhibition, remarked that, since airports and airways were a matter for vital planning, all architects, as professional planners, were directly concerned with these projects.

Lord Swinton spoke of the necessity for making air services self-supporting at the earliest possible moment, and said that the organisers of the exhibition had performed a very real service. Although airports could not at present be expected to pay for themselves, the cities which had laid them out had shown vision, public spirit and, he believed, sound common sense; the time would come when these airports paid for themselves in cash as well as public service. Meanwhile, there was no reason why utilitarian buildings should not also show the æsthetic decencies.



Lord Swinton, accompanied by Mr. P. E. Thomas, president of the R.I.B.A., examines the Air France sectioned model of the Farman Centaur.

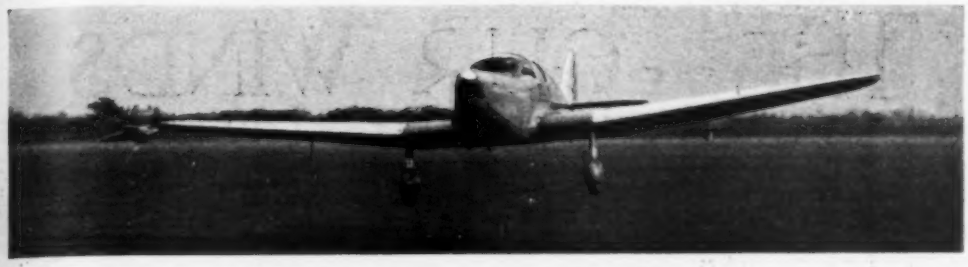
Photographs—many of them the work of *Flight* photographers—form the bulk of the exhibits.

The most apt and amusing speech came from Mr. H. S. Goodhart-Rendel, the chairman of the exhibition sub-committee, who proposed the vote of thanks to Lord Swinton. He said, among other things, that the average person treated architects as if they had but one reason for existence—to tone down the inevitable unsightliness of useful objects.

The exhibition itself may be described as a "static" one. A number of models of aircraft and airports are shown, but the bulk of the exhibits consists of really excellent photographic enlargements (many by *Flight's* photographers) of machines and airport buildings throughout the world. Only so can interested visitors be made to see what has actually been done and, consequently, what can be done in the future.

The kernel of the exhibition is undoubtedly the large model of the "perfect" airport layout, which was prepared by two members of the committee. A simple runway system is used, the approaches being arranged so that the buildings (which form the shaft of the broad runway "spearhead") do not interfere with them. A D/F aerial system is arranged behind the buildings and approach road. Other models show Jersey's new airport buildings—a very pretty layout—and Gatwick, with its Martello tower central building and its extensible gangways.

Among the many photographs, which cover survey and archæology as well as aircraft and airports, there are some interesting diagrams showing how bearings are taken and given and the extent of London's controlled zone system.



MAYA MILES

A New Flying Test Bed for the Villiers Maya Engine : Detail Improvements

SINCE the prototype Villiers-Hay Maya I engine was originally described in *Flight* of April 23 last year, it has been through vigorous Air Ministry tests and has undergone one or two minor improvements. Furthermore, it is now installed very neatly in a Miles Whitney Straight—improving, rather than otherwise, this machine's already attractive lines. Previously, a B.A. Eagle had been used for the flying tests.

It may be remembered that the Maya is a four-in-line air-cooled engine with normal aspiration; small frontal area, adequate cooling and a good power-weight ratio have been the major features aimed at by the designer, Mr. Amherst Villiers. Though an in-line engine, it has many of the features of the modern radial, with a hemispherical head, splayed valves and deep, close finning. The splaying of the valves permits a wide cooling trough down the entire length of the head, and these valves are operated through short enclosed push-rods from the special four-bearing camshafts inside the Elektron crankcase. Radial practice is also apparent to some degree in the use of a species of "pressure cooling."

Later improvements include a new induction system, the design of which enables full throttle to be used with the warm air intake and flame-trap in action. A change-over, operated by push-pull control on the dash, enables the pilot to use the direct cold or the hot air intake at will, and the loss of power on full-throttle when the latter is in action is small enough to be unnoticed; only for the take-off is it preferable to use the direct intake position of the control.

The compact installation of the 135 h.p. Villiers Maya engine in the Miles Whitney Straight. The hot-or-cold-at-will air intake manifold can be seen in this view, which also shows the admirably short fuel and oil lines.

In its developed form, the Maya has a compression ratio of 6 to 1, giving a maximum output of about 135 b.h.p., as compared with the 125 b.h.p. of the original engine, for which the ratio was 5½ to 1.

The installation in the Miles Whitney Straight is certainly very neat indeed. Apart from the fact that the cowling itself is tapered towards the nose, conditions inside this cowling are the essence of tidiness.

Villiers Maya pistons, a gudgeon pin, and con-rod. The pistons have three compression rings and two scrapers apiece.

A stripped inspection by the Air Ministry after the 100 hours' running showed that all parts were in good condition. The original grinding marks, for instance, were visible in the cylinders and the 1 deg. taper on the rings was intact.

A member of *Flight's* staff was in the machine, either flying himself or with Mr. Villiers, for upwards of an hour, but a continuous series of wind-bumps, from ground level to the cloud-base at 5,000 ft., prevented any really useful A.S.I. readings from being taken. The steadiest results were obtained at 5,000 ft., the indicated speed being just short of 130 m.p.h. at 2,400 r.p.m.—cruising revolutions. Allowing for altitude corrections to the instrument and for the possibility that height was, in fact, being lost at a rate which was not noticeable on the standard altimeter, the actual speed was probably in the region of 138-140 m.p.h. At full throttle, 1,000 ft. and 2,650 r.p.m., the corrected maximum appeared to be a little over 150 m.p.h., though bumps swung the needle too violently for accurate indications.

Such figures cannot stand without reference to take-off run, and here again the very windy and bumpy conditions militated against any rough timing test. It was, in any case, necessary to hold the machine down in order that maximum control should be available as soon as the machine was in the air.

Various tests, including level and steep climb throttling back, did not show any direct vibration. In the ordinary course of events there was not a shade of vibration or roughness throughout the throttle and speed range.

Production negotiations are now in progress, and the design work on a larger version, the Maya II, is well in hand.

THE FOUR WINDS

ITEMS OF INTEREST FROM ALL QUARTERS

A SPECIAL high-speed aircraft rescue ship, the *Hans Rolshoven*, was launched recently at Hamburg.

Colonel and Mrs. Lindberg arrived at Karachi in their Miles Mohawk last Saturday. It is believed that they will tour India.

Mlle. Vivienne Elder, the French airwoman was rescued from the sea, thirty miles from Tunis, on Sunday, while flying to Cairo for the international rally.

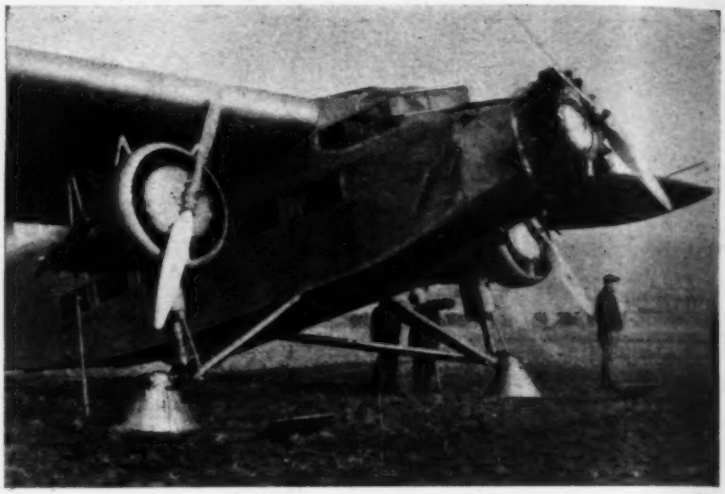
The German Ambassador, Herr von Ribbentrop, attended the annual commemoration service in Potters Bar churchyard last Sunday at the common grave of the crews of the two Zeppelins brought down at Cuffley and Potters Bar in 1916.

Three types of Armstrong Whitworth Whitley heavy bomber are being built. The Whitley I has Tiger IX engines, the Mk. II version uses Tiger VIIIs with two-speed superchargers, while the power plants for the third model have not been definitely chosen.

Thirty-six Junkers Ju. 86 bombers soon to be delivered without engines to the Swedish Air Force are being acquired by barter, the "price" being agricultural and industrial products to the value of about nine million kronor. Finland has placed an order for a dozen German bombers.

An "International Glider Competition," to be held on the Wasserkuppe, will be organised by the Aero-Club von Deutschland, from July 4-18. A nation may enter up to five seaplanes, for each of which two pilots may be nominated. An "International Aviation Meeting" is being planned by the same body, the probable date being July 11, and the place Frankfurt-on-Main.

A Coronation air display is to be held at Leicester Airport, Braunstone, on Thursday, May 13, the day following the Coronation. Aviation in the whole of the county will be represented, the display being organised by the Leicestershire Aeronautical Co-ordination Committee, formed at a luncheon meeting at the instigation of Mr. W. Lindsay Everard, M.P., Chairman of the Royal Aero Club.



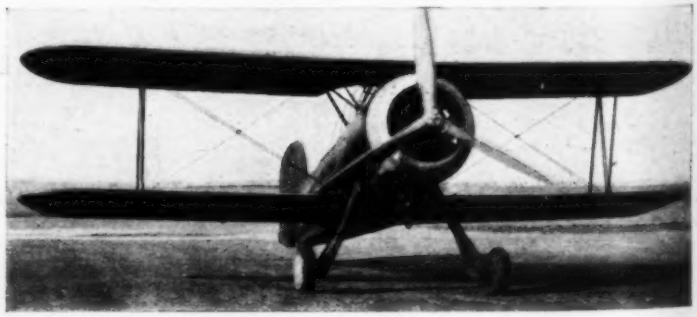
SOURDOUGH : A real old-timer from the frozen wastes of Alaska, this Ford tri-motor flew down to Boeing Field complete with skis and made an exemplary landing on the snowless grass.

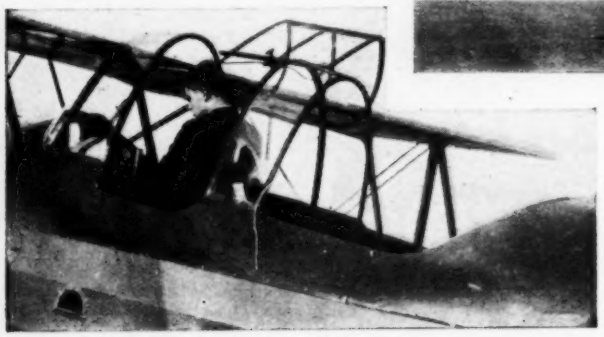
The total value of contracts placed by the Air Ministry in the present financial year up to December 31, amounted to £67,122,500.

The observation tower which is being built in Bellahouston Park, Glasgow, for the Empire Exhibition of 1938, will rise to more than 500 feet. It is being built on the highest point of the Park and a powerful light will be fitted to provide a warning beam for aircraft, as the tower is only four miles from the aerodrome at Renfrew.

To-night's R.Ae.S. lecture will be given by Mr. N. S. Muir, whose subject will be "The Measurement of Engine Power in Flight." He will describe a new flight-testing transmission dynamometer.

The B.B.C.'s broadcast of the "R.F.C." concert party "Flying High," last November, was so popular that in the next performance, on March 29, the effective scheme of periodically switching from the concert party atmosphere to "reality" will be much extended.





DOUBLY DEADLY : The two-seater fighter is a type well represented in the world's air forces. Holland's newest is the Koolhoven F.K. 52 with one of our own Bristol Mercurys of 830 h.p. maximum. The cantilever undercarriage is reminiscent of the Gladiator. At 14,400 feet the new Koolhoven does about 230 m.p.h. An interesting cockpit enclosure has been evolved, as shown on the left, the rear portion housing a special Koolhoven machine gun mounting.

POLICING the EMPIRE

Functions of the R.A.F. : Informative Paper by Air Comdre. C. F. A. Portal

THERE are two separate functions for the Air Force when policing the Empire, said Air Commodore C. F. A. Portal, D.S.O., M.C., when he read an unusually interesting paper before the Royal United Service Institution on Wednesday of last week, under the chairmanship of Air Chief Marshal Sir Robert Brooke-Popham, G.C.V.O., D.S.O., etc., the Governor-designate of Kenya. These two functions are (1) work in fully administered territory, when the Army is the senior partner and the Air Force works as its junior, and (2) work in unadministered or loosely administered territory, where the Air Force works by itself.

Air Commodore Portal was introduced by the chairman as a well-qualified authority, who was educated at Winchester and Oxford, enlisted as a sapper, and afterwards had graduated at the R.A.F. Staff College, Andover, the Naval Staff College, Greenwich, and the Imperial Defence College. He made the interesting suggestion that air transport might justify a new type of soldier, real light infantry, "flyweight" battalions of small but determined men, from whose ranks they would eliminate the corpulent and the airsick.

He then turned to the question of control in loosely administered lands, instancing Aden, where he had been in command. The protectorate consists of 40,000 square miles, two-thirds mountainous and one-third desert. There were no proper roads, but a number of caravan tracks converging on the port. The needs of the Government were that British officers must be free to travel about in safety; the trade routes must be safe; and if two tribes must fight they must not be a nuisance to their neighbours.

In 1928 the R.A.F. took over responsibility for the control of the country. The lecturer did not approve of the policy of "bomb and scuttle." Bombing empty villages and destroying crops would never bring a tribe of spirit to order. It only provoked them, and failed because it did not bring about a change of heart. The present Air Force method was much more subtle and scientific. He illustrated it by telling a story of operations in 1934, when a tribe raided the first caravan which came out of the Yemen, attacking it sixty miles north of Aden. The raiding tribe was a brave one which had defied the Turks in the old days. A political officer flew to a neighbouring part and interviewed the Shaikh of the tribe, who admitted its guilt. An ultimatum was then sent, imposing a fine and a demand for surrender of the guilty parties or hostages in their place. It was always important to give the tribe an alternative. The ultimatum must be sent quickly, but ten days were given for reflection before air action was taken. In those ten days No. 8 (Bomber) Squadron photographed the area, verified all its information, planted agents, and completed all preparations. On the appointed day the tribe naturally vacated its villages and moved off to caves in neighbouring hills. Then the squadron bombed the houses of the Shaikh and the chief instigator, but did no further damage. Occasionally bombs were dropped in fields, and each evening a few delay-action bombs were dropped which would go off at intervals during the night. When the tribesmen began to say that the R.A.F. were bad shots the bombers flattened out a small village just to show that they could hit things when they wanted to do so. Every day one aircraft patrolled over the area, and if any tribesman ventured on to the lands he was driven off by a few machine-gun bullets in his direction. This was kept up for two months.

At first the tribesmen were excited and defiant. They shot at the aircraft, but missed them. Then they began internal squabbling, one section wanting to make terms, while others were obstinate. Then, as the rains approached, and they knew that they would get no crops unless they could begin work on their fields, there came a period of what the lecturer called "wistful boredom." Then other tribes began to jeer them. Finally came offers to talk things over, and then it was for the Government to make it easy for them to submit, though the stated terms must always be exacted. After negotiations by an intermediary Sultan, the terms were accepted, the fine paid, and the hostages given up. The Political Secretary flew out to the tribe, and he was received with fervent cheers.

SERVICES RUGBY : R.A.F *v.* ROYAL NAVY

WHEN a Rugby XV wins or draws a match by means of a penalty goal there is often a general tendency to regret the fact. In the match at Twickenham last Saturday the Navy scored one try and the Air Force never crossed their opponents' line; so, say some, the Navy deserved to win, and the draw was bad luck on them. This overlooks the fact that when an attacking side is baulked by a breach of rule by the defenders it may be deprived of a placed goal (value 5 points) and is only allowed to score a penalty of the value of 3 points. In the first half of this match the R.A.F. *might* have crossed the lines three times, had not the Navy men—not deliberately, of course, but in the excitement of the moment—baulked them by breaking rules. So the R.A.F. lost a chance of 15 points and only scored three. And, if only P/O. J. A. Roncoroni had had on his kicking boots, the R.A.F. might easily have scored nine points out of their three free kicks from easy positions. So, the Navy cannot fairly say that they had bad luck in not winning.

The game may be summarised as two good keen packs of forwards, the R.A.F. better in the loose in the first half and the Navy better in the second; two sets of outsides whose deadly tackling was a sheer joy to watch, but whose ideas of developing combined attacking movements were rudimentary, and a first-class display of full back play by F/O. R. H. Platt. The natural result was that the game largely consisted of a routine of scrum, heel, pass, tackle, pass, fumble, scrum, and then the same over again. On the R.A.F. side the main trouble was that most of the passes given were too high, and the man who had to take them had to check speed while he gathered, and so gave time for the determined Navy tackler to wrap himself round the R.A.F. waist.

The Air Force captain, F/O G. A. Walker, was closely marked, as men with England Trials caps usually are. Nevertheless, he several times found a partial gap and darted through it at great speed, but he was never backed up, and after dodging three of four Navy defenders he was inevitably brought down. There always seemed possibilities about P/O. G. L. Malcolmson, the Ireland international, but the indifferent passing never really put him into a strong attacking position.

On the Navy side Lieut. W. Elliot, the former fly-half for England was said to have had influenza not long ago, and certainly he was rather subdued. The Navy centre three-quarters made several good breaks through in the second half, but, except for the time when Hurden took the pass to score in the right corner, they were individual efforts and not combined movements. Except for that once the R.A.F. tackling always proved adequate, even if the last line of defence was reached.

Platt, the Air Force full back, gave a great display. He had more to do than fell to the Navy full back, because many Navy kicks failed to find touch and Platt had a chance to send them back. His kicks, on the other hand, were almost invariably really long ones, and they nearly always found touch at the end of their carry, which gave the Navy full back no chance of showing his merit. Platt also kicked the penalty goal after Roncoroni had missed two easy kicks.

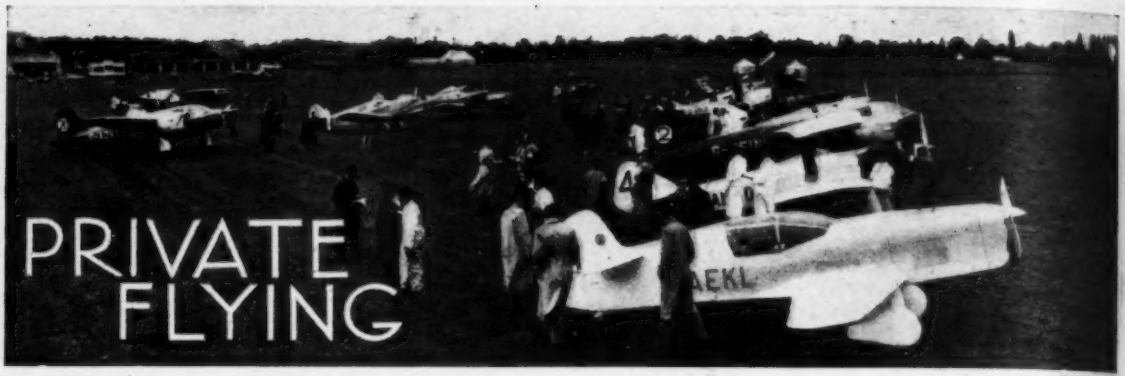
The R.A.F. forwards surprised everyone by heeling more often than not, despite the greater weight of the Navy pack.

The actual course of the game is hardly worth describing. The R.A.F. attacked all the first half when they had the wind behind them, and scored their three points just before the interval. The Navy attacked most of the second half, and their try came after twenty-eight minutes' play in that half. A draw was certainly the right result.

The teams were :—

ROYAL NAVY.—Paymaster-Lieut. J. E. Stevens, Shipwright R. Hurden, Sub.-Lieut. K. D'O. Nott, Surg.-Lieut. B. M. Goldsworthy, Lieut. R. S. Casement, Lieut. W. Elliot (capt.), Sub.-Lieut. E. B. Talbot, Ldg.-Telegpt. Stovell, Sub.-Lieut. D. N. Callaghan, Lieut. (E.) I. G. Aylen, Lieut. (E.) N. L. Evans, Marine C. Webb, Lieut. R. J. L. Hammond, Lieut. G. P. Darling and Paymaster-Lieut. H. C. Lyddon.

ROYAL AIR FORCE.—F/O. R. H. Platt (Odiham); P/O. G. L. Malcolmson (Grantham); Flight Lieut. K. B. B. Cross (Duxford); P.O. A. V. Rogers (Upper Heyford); P.O. P. J. Halford (Farnborough); F/O. G. A. Walker (Eastchurch); P/O. G. R. Shepley (Old Sarum); A.C.I. G. Greaves (Digby); Sgt. L. Fox (Felixstowe); F/O. R. H. Waterhouse (Lee); F/O. C. H. Beamish (Halton); P.O. J. A. Roncoroni (Upper Heyford); Sgt. W. F. Gascoigne (Upper Heyford), F/O. P. S. Hutchinson (Uxbridge); A.C.I. J. Holland (Hendon).



Super-cushioning

LAST week I learnt something more about low-wing machines and, particularly, about the use of flaps in a high wind. The facts are not guaranteed, since coincidence may have played an unexpectedly big part, but they are at least worthy of attention—and possible destruction by the pens of those who know a good deal more about the theory than I do.

On this occasion I was flying as a sort of active passenger in a low-wing machine while an approach was being made with the flaps fully down into a wind which was gusting up to 30 m.p.h. or so. Just as we were levelling off at a comparatively high air-speed the machine was urged upwards without noticeable control movement (and without touching earth) to a matter of eight feet or so, whence descent was only made with the help of engine and a good deal of pump-handling.

The impression I gained was that the normal low-wing cushioning effect was so exaggerated that the machine was, in fact, bounced back into the sky, and this idea appears to be borne out by my rule-of-thumb theory.

Were it not for the fact that both a machine of the same make and another unflapped low-winger performed much the same evolution very shortly afterwards I should have blamed the effect of a sudden gust. The wind-strength was, after all, of a Beaufort scale magnitude which equally prevented instruction and the removal of any lightly loaded biplane from its hangar.

However, fortified by a good lunch, I went out afterwards with the same machine and had a try myself. This time, however, I cautiously used the half-down position for the flaps (yes, it was a Miles Whitney Straight), and the result did not appear to cause heart-failure, either to the other occupant of the machine or to the watchers on the tarmac. The machine still had to be held *down* during the hold-off, and it flew again, at an altitude of one foot, after a finally stalled three-pointer, but the air-bounce effect was not at all marked. I can only suggest that we should be cautious in the use of flaps when the wind-speed exceeds 20 m.p.h.

Graduation

APROPOS my remarks the other week about low-wing technique, I was recently told of some interesting training comparisons obtained at a club where both low-wing monoplanes and conventional training biplanes are used.

The instructor in this case found that, generally speaking, pupils who had been taught on the monoplane—which, as it happens, is a particularly easy, foolproof, but buoyant device—are passed off as safe on the biplane after less dual instruction than is necessary when the order is reversed. In other words, the man or woman who had mastered the somewhat balloonatic technique required for the monoplane found the brick-like biplane to be easy going, while those who had become accustomed to the brick, and to a side-slipping approach technique, were somewhat out of their element when dealing with the monoplane. As a certain pupil once remarked, this machine flies as if its thick wing were full of a particularly light gas.

All of which rather scuppers the argument of so many conservative instructors who claim that it is a mistake to teach people on a type which is easy to fly and without real vice. I am in favour of making the initial stages, when inferiority complexes so often cloud the pupil's mind, just as easy as possible. Later on, the sadistically inclined instructor can bring out his finest flying coffin in order to remove any sign of conceit in his more ambitious pupils. What should we say if the road licence testers insisted that all applicants should be tried out on a car with oval wheels and a pronounced tendency to make sudden dashes towards the nearest ditch? Or one which, when its speed was reduced below a certain figure, started to accelerate rapidly towards the nearest brick wall or other hard and uncompromising object?

In fact, of course, nothing matters very much except the instructor. Given similar material, a good teacher will produce good pilots, while a poor or careless one will turn out proportionately more careless menaces. Club instructors who leave their more advanced pupils too much to their own devices please note. A little refresher dual does no one any harm.

All Hands

WHAT with flaps, wheel-brakes, flame-traps, v.p. airscrews, and boost (or pseudo-boost) gauges, the pilot even of the modern light aeroplane has a very great deal to look after. Consequently, control and instrument placing is becoming a matter of really paramount importance.

On quite a few less complicated aeroplanes it is necessary to fly with either hand alternately, and I suggest that, where it is at all possible in the layout, every control which requires attention at more or less the same time should be placed on one side or the other. Only by such a planned arrangement will it be possible to remove the necessity for a manual change-over at some critical moment during, for instance, the approach. This change-over may be uneventful in itself, but is liable to upset things when a particularly accurate approach is being attempted into a small aerodrome or field.

In any case, the amateur pilot of to-day must, as I have said before in these comments, be ambidexterous. After a certain amount of necessary experience with my left hand I feel fairly happy in the air, whether in normal flight or during the approach, but I am still hesitant about pulling off a landing in conditions which might demand very accurate throttle work at the same time. I must do some left-hand dual—practicing landing with motor both on and off.

INDICATOR.

FROM the CLUBS and SCHOOLS

ALL MODERN CONVENIENCES : Reminiscent in layout of our own Miles Whitney Straight the American Aeroneer is of full stressed-skin construction and does 147 m.p.h. with a 125 h.p. Menasco C-4 engine. Alternative installations are the Menasco B-4 (95 h.p.), C-4S (150 h.p. at 3,000 ft.) or B-6 (160 h.p. at sea level).

LEEMING

EXCESSIVELY high winds brought down the flying time last week to 16 hr. 10 min. Major Shaw's Avro Commodore visited York aerodrome

YORKSHIRE

Bad weather brought down the flying time last week to 8 hr. 55 min. Flights were made to Sherburn, Manchester and Hull. The Club was visited by a D.H. Dragon (G-AEKZ), of Air Commerce, piloted by Mr. W. Coates.

LIVERPOOL

Flying times for February, to the 20th, totalled 92 hr. 15 min. Weather conditions during the month have been exceptionally bad, with high winds and rain. An informal dance will be held in the clubhouse at Speke on Grand National night, Friday, March 19, commencing at 8.15 p.m.

HERTS AND ESSEX

Weather at Broxbourne aerodrome during the past fortnight has been anything but good, and has kept the flying total down to 65 hr. 44 min. Messrs. R. Myers, L. Goodwin, L. F. W. Bamber and R. A. Payne have become members, while Mr. A. R. Saward has passed the passenger-carrying tests.

SOUTHEND

High wind and fog prevented flying until the week-end, and then on Saturday and Sunday the machines were only on the ground to allow for refuelling. On Sunday Mr. Whitney Straight gave a personal demonstration of the Miles Whitney Straight. Both the president and the chairman took the air with him and were most favourably impressed. The Club are holding their Sixth Birthday Dance on Saturday, February 27, at 8 p.m.

BROOKLANDS

The usual British weather contrived to keep down the flying time for the week, but Sunday relented somewhat and eighteen hours were flown, this bringing the week's total up to fifty-five. During the week Mr. Ezekiel made a first solo. Sunday was a day of cross-country flying. The Hon. Ruth Çokayne and Miss Friedlander took a machine to Wilmington, afterwards going to Shoreham, where Capt. Davis, Major and Mrs. Shearer, and Messrs. Bremridge, Bishop, Gunn, Howard, Banks, Lovell and James had flown direct. After luncheon the party returned to Brooklands where the B.A. Drone was being demonstrated by Mr. Kronfeld. The sales department has been busy during the last few weeks. Since January 1 Mr. Massey has sold three Whitney Straights, three Gipsy I Moths, one Gipsy II Moth, two Puss Moths, two Hawks and one Monospar. A new member during the week was Mr. F. Howard, and another to renew acquaintanceship with Brooklands was Mr. Lessel Hutcheon, who did his first solo at the aerodrome in a Maurice Farman Longhorn in 1915. During the week the Imperial Airways machine *Dana*, out on a test flight in QBI. conditions, landed at the aerodrome with the wireless out of action. Having telephoned Croydon for permission to come into the controlled zone it left on its lawful occasions.

LONDON

In spite of the fact that there were only four flying days last week, the Club put in 54 hr. 30 min. flying. New members are Messrs. L. Blow, W. J. Craig and J. Sillery, the latter having completed the tests for his "A" licence.

YAPTON

Flying times for February to the 20th totalled 49 hr. 30 min. Mr. D. F. Holland has carried out both solo cross-country test flights and passed the technical examinations for his "B" licence, while "A" licence tests have been passed by Mr. B. C. Ling and R. A. Hubbard.

BRISTOL AND WESSEX

For the fortnight ended February 20 flying times totalled 18 hr. 5 min. Mr. J. H. Hickman has gone solo, and Mr. D. W. L. Fairbank has joined as a new member. The Miles Whitney Straight was demonstrated on Sunday, February 21. A social evening with the local branch of the Comrades of the Royal Air Force has been arranged for March 8.

CAMBRIDGE

Flying times at Marshalls' Flying School for the week ended February 21 totalled 40 hr. 25 min. Mr. Sen and Mr. Gallyon have joined the School, and Mr. English has passed the tests for his "A" licence. Several members have been doing a good deal of blind flying in preparation for the tests for their Cambridge Air Pilot's certificates. The Puss Moth was chartered during the week for a trip to Liverpool, and was also taken by a member to Lympne, while the Monospar was taken by a member and a party of friends to Hatfield.

C. A. S. C.

A large number of people attended at Gravesend airport for the first official day's flying of No. 4 Squadron. Flying totalled three and a quarter hours dual and approximately five hours solo, many relatives and friends of members taking advantage of the "open" day to make their first flights. On Sunday members flew 10 hr. 30 min. at Cambridge, the C.O. flying to Gravesend to attend the inaugural meeting of the Kent Squadron. On Thursday last over 350 members and friends attended a very successful dance at the First Avenue Hotel, London.

CINQUE PORTS

The aerodrome at Lympne was completely fog-bound for four days out of the seven last week, and this naturally had an adverse effect on flying hours. Plans are rapidly going ahead for the erection of new Club buildings, which will comprise twelve bedrooms, a lounge for residents to be built over the existing pilots' office on the tarmac, commanding a view of the aerodrome, and quarters for a resident steward. It is hoped that these will not only prove welcome to the resident "B" licence aspirants, but also to the unfortunate travellers who, through no fault of their own, find themselves obliged to land at Lympne. The annual dinner and dance to be held on March 12 promises to have a record attendance, judging from the demand for tickets.

Private Flying

REDHILL

The flying hours for the week ended February 19 totalled thirty-six. Thirty members attended the anti-gas lecture and drill on February 19. There are four new flying members, and Mr. Chalk has made a first solo.

JOHANNESBURG

On February 28 Capt. Halse will leave his position as Captain of the Johannesburg Light Plane Club. He is taking up an appointment with the Anglo-American Corp. The flying time during January totalled 326 hours. Five new pupils were enrolled, one member made a first solo and one obtained his "A" licence.

SOUTH COAST

Rather bad weather during the past week limited flying almost entirely to the more experienced members of the Club, and to the more advanced of the "B" licence pupils. Flying has, therefore, totalled only just over twenty hours. A very successful dance was held on Saturday, over a hundred members attending, including a large contingent from Brooklands.

HANWORTH

Boisterous weather kept things quiet at Hanworth during the week, bringing the total number of flying hours to 22 hr. 20 min. New members are Miss R. Berger, Mr. Almack, Mr. R. B. Lord and Mr J. Jones, while first soloists were Mr. J. Stone, Mr. W. Padgett (National League of Airmen), and Mr. P. Powell. The Aeronca was demonstrated at Ipswich and Stapleford during the week by F/O. A. E. Clouston. The Club has been elected to the General Council of the Association of Light Aeroplane Clubs.

The Willingdon Challenge Trophy

APPLICATIONS for the Willingdon Challenge Trophy should now be sent to the Secretary, Aero Club of India and Burma, New Delhi. They should reach him on or before March 31.

Gliding in India

IF the Indian Gliding Association's scheme materialises, and if public support is forthcoming, gliding is likely to take a real place in Indian aviation. The Governor of Bombay, it appears, has promised his support.

Very shortly a number of German pilots, with their sail-planes, will visit India to train people under the auspices of the association, which has obtained a plot north of Tata's aerodrome at Juhu (Bombay). The work has been taken in hand.

The I.G.A. was started in 1931 when three machines were purchased and an aerodrome provided free of cost in Aundh State. The movement did not spread because of the inaccessibility of the place. The thermal currents prevailing in India are reputed to be the best obtainable in the world, and this fact was a material inducement to the proposed deputation from Germany.

A Club for Boston

PRELIMINARY negotiations have been completed for the construction of an aerodrome and the formation of a flying club at Boston, Lincs. The Air Ministry have approved a site on the Sleaford Road, about a mile from the centre of the town. It is proposed to form a company with capital of £10,000 to finance the scheme.

Cubbing in Denmark

FOR some time plans have been discussed in Denmark concerning the manufacture of light aeroplanes. Two different parties were interested. One was represented by Mr. Jack Hedegaard, a Danish-born aircraft engineer in the employ of the American Taylor concern, while the other party was backed by the Danish shipping company, Ostasiatiske Kompagni. The latter aimed at manufacturing for the Danish market only, but Mr. Hedegaard planned to make Denmark the European centre for the manufacture of Cubs.

The Danish Minister of Trade recently announced that the Government had made a decision in favour of Mr. Hedegaard's application, on condition that co-operation is sought with a shipbuilding works owned by the Ostasiatiske Kompagni. It is understood that Taylor Aircraft will concentrate on supplying the American market only, leaving the rest of the world to the attention of the Danish subsidiary concern as far as Cubs are concerned.

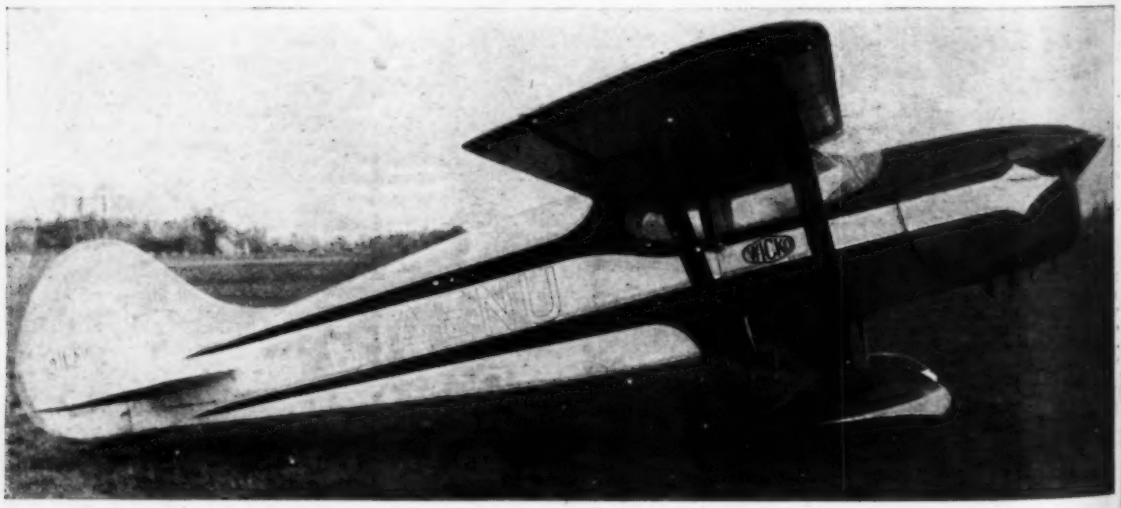
The Oases Meeting

FORTY-THREE aircraft, among which are seventeen British entries, assembled at Almaza Aerodrome, Cairo, last Monday for the Egyptian Rally.

The meeting, which ends to-morrow, has as its outstanding events two distinct races. One is a circuit of the Oases, the route to be followed being Almaza to Ghobeit el Bos (on the Gulf of Suez), down the Red Sea to the 34 degrees longitude, then to Assuan, Luxor, Nag Hamadi, Kharga, Dakhla, Farafra, Baharia to Almaza again. The second is a speed competition, which will take place over a short triangular course around Almaza.

The British entries are as follows:—

F. C. J. Butler (D.H. Hornet Moth), E. D. Spratt (Miles Falcon), O. G. E. Roberts (Monospar S.T.12), Mabel and Sheila Glass (D.H. Moth), P. G. Aldrich-Blake and S. B. Cliff (Percival Vega Gull), C. G. M. Alington (Miles Hawk), C. E. Gardner (Beechcraft), R. K. Beale (Short Scion), Miss Lily Dillon (B. A. Swallow), Major J. C. Hargreaves (B. A. Eagle), F. Hills and Sons—pilot, J. Shoesmith—(Hillson Praga), Capt. J. K. Mathew (Miles Hawk Major), 2nd Lt. V. A. P. Budge (Miles Hawk Major), A. Ellison (D.H. Puss Moth), G. A. M. Vandeleur (Miles Hawk Major), James Hairlip (Beechcraft), and Flt. Lt. J. Heber-Percy.



CIRRUS ENGINED: In its latest form the Wicko monoplane is fitted with a 90 h.p. Cirrus Minor engine and flaps. The cruising and maximum speeds are now 105 and 120 m.p.h. respectively, and the cruising range is 450 miles with two occupants and baggage. A batch of six machines are now going through, and new premises have been taken over at Southampton airport.

THE ROYAL AIR FORCE

SERVICE NOTES AND NEWS — AIR MINISTRY ANNOUNCEMENTS

STAFF COLLEGE, CAMBERLEY

The undermentioned officers have completed satisfactorily the course at the Staff College, Camberley, which terminated in December, 1936:—

Wing Cdr. M. Moore, O.B.E., *p.s.a.*, and Sqn. Ldr. W. Elliot, D.F.C., *p.s.a.*

ROYAL NAVAL STAFF COLLEGE

The undermentioned officers have completed satisfactorily the course at the Royal Naval Staff College, Greenwich, which terminated in December, 1936:—Wing Cdr. G. E. Livock, D.F.C., A.F.C., and Sqn. Ldr. (Acting Wing Cdr.) W. M. Yool, *p.s.a.*

SPECIAL 1ST TORPEDO COURSE

The undermentioned officer, having successfully completed the torpedo course which terminated on November 27, following the specialist course at the Royal Air Force School of Aeronautical Engineering, is granted the symbol "E (T)":—Flt. Lt. N. C. Walker.

R.A.F. RUGBY UNION

Air Marshal Sir Arthur M. Longmore, K.C.B., D.S.O., has kindly consented to succeed Air Chief Marshal Sir Robert Brooke-Popham, G.C.V.O., K.C.B., C.M.G., D.S.O., A.F.C., as President of the Royal Air Force Rugby Union.

AIR ARMAMENT SCHOOL

The undermentioned officers, having successfully completed the specialist armament course at the Air Armament School, Eastchurch, are granted the symbol "A":—Flt. Lts. F. C. de la P. Beresford-Peirse, A. N. Combe, H. Y. Humphreys, E. C. Ingham, D. S. Kite, I. G. Mackay, and E. D. MacK. Nelson.

The following officer also successfully completed the course:—Lt. L. A. Wilmot (S.A.A.F.).

FORMATION OF ANTI-AIRCRAFT CO-OPERATION UNITS

No. 2 Anti-Aircraft Co-operation Unit formed at Lee-on-the-Solent on February 15 and includes No. 1 Gunnery Co-operation Flight which ceased to exist as a separate unit from that date. The new unit has been placed in the Coastal Command in No. 17 (Training) Group.

No. 3 Anti-Aircraft Co-operation Unit will form at Hal Far, Malta, on March 1, and will include No. 2 Gunnery Co-operation Flight which will cease to exist as a separate unit from that date. The new unit will be placed in the R.A.F. Mediterranean Command.

PERMANENT COMMISSIONS AND MEDIUM SERVICE

Sixty-three officers who sat for the examination held in November, 1936, reached the qualifying standard. Specialisation vacancies will be allotted to the first sixteen, whose names are given below in order of merit:—

(A)

F/O.s Hurley, H. B., Birch, S. G., Musson, R. G., Thomas, J. B. P., Gibson, L. P., Richardson, F. C., Sarsby, C. F., Seys, R. G., Theed, W. A., Thomson, G. J. D., McKay, K. J., Leggett, D. N. J. P., Bandidt, A. F., McWhannell, P. A., Flt. Lt. Palmer, E. J., F/O. Robinson, B.

SELECTED FOR NON-SPECIALIST PERMANENT COMMISSIONS

Flt. Lts. Hobler, J. F., and Lee, H. G.; F/O.s Alloway, H. V., Blomfield, O. H. D., Craig, R. J. F., Dunn, P. H., Gatheral, G. H., Gilbart-Smith, N. D., Golledge, G. W., Graham, W. M., Hodder, C. C., Hutchinson, P. S., Loudon, F. M., Rump, F., Selby, J. P., Shepherd-Smith, J., Spencer, L. V., Strutt, A. G., Taylor, C. R., Thomas-Ferrand, H. M. W.

SELECTED FOR MEDIUM SERVICE

F/O.s Bertram, S. S., Birch, A. M. A., Boult, N. de W., Cane, A. P. W., Clarke, E. H. P., Cooper, F. E. H., Gibbings, P. H., Glasheen, V. W., Gregory, R. R., Gyll-Murray, J. E. C. G. F., Hilton, P. C., Hollick, A. P., Jackson, G. E., Lynham, V. H. P., McCarthy, J. J., Marwood-Elton, N. W. D., Meagher, P. E., Misselbrook, S. T., Mulliken, A. M., Nugent, F. D., Pattison, R. V. L., Paul, B. J., Solbé, E. U. G., Southwell, J. M., Taylor, J. C., Toland, G. T., Waterhouse, R. H., West, H.; P/O. Holford, H. A. R.

MARINE CRAFT

The Air Ministry is offering commissions to officers of the Royal Naval Reserve for duties with R.A.F. marine craft.

No. 3 FLYING TRAINING SCHOOL

The undermentioned officers and airmen have been awarded special assessments on completion of a course of flying training at No. 3 Flying Training School, Grantham:—

Special Distinction

Acting P/O. A. G. Malan.

Distinguished Pass

Acting P/O.s I. G. Morrison, G. G. Storey, W. P. F. Treacy, and C. A. Turner; Acting Sgts. Freeman, T. O., and Wheeldon, G. R.

No. 4 FLYING TRAINING SCHOOL

The undermentioned officer and airman have been awarded special assessments on completion of a course of flying training at No. 4 Flying Training School, Abu Sueir:—

Distinguished Pass

Acting P/O. R. W. Gautry, and Acting Sgt. Jones, C. A. T.

No. 6 FLYING TRAINING SCHOOL

The undermentioned offices have been awarded special assessments on completion of a course of flying training at No. 6 Flying Training School, Netheravon:—

Distinguished Pass

Acting P/O.s B. MacCallum, G. V. Smither, and T. R. Thomas.

No. 10 FLYING TRAINING SCHOOL

The undermentioned officers have been awarded special assessments on completion of a course of flying training at No. 10 Flying Training School, Tern Hill:—

Distinguished Pass

A.P/O.s W. B. G. Bonsey, M. F. Hendry, and G. E. Newton.

ADEN

As from April 1, 1937, the contribution by the Government of India towards the cost of the Aden garrison will be discontinued.

STUDY OF MODERN FOREIGN LANGUAGES

Swahili has been added to the list of languages for which tests for colloquial proficiency are held.

A CHANGE OF TITLE

The anti-aircraft co-operation unit at Biggin Hill will be named No. 1 Anti-Aircraft Co-operation Unit with effect from February 10, 1937.

R.A.F. STATION, THORNABY

The refuelling facilities at Thornaby are limited, and aircraft are not to land there for refuelling except in emergency.

No. 41 SQUADRON DINNER

The annual reunion dinner of officers of No. 41 Squadron will be held at the Café Royal, London, W.1, at 7.30 p.m. for 8 p.m., on Saturday, February 27. The chair will be taken by Group Capt. F. Sowrey, D.S.O., M.C., A.F.C. Tickets—15s. 6d. each, including wine—may be obtained on application to the honorary secretary, P/O. G. E. Wallace, No. 41 Squadron, Royal Air Force, Catterick, Yorks. Cheques should be made payable to No. 41 Squadron Dinner Fund. Evening dress (with miniatures) will be worn.

R.A.F. BENEVOLENT FUND

The usual meeting of the Grants Committee was held at Iddesleigh House on February 8. Air Vice-Marshal C. A. H. Longcroft, C.B., C.M.G., D.S.O., A.F.C., was in the chair. The Committee made grants to the amount of £434 14s. 6d. The next meeting was fixed for February 22.

FOREIGN OFFICERS WITH THE R.A.F.

Capt. Nepakas, of the Siamese Air Force, has been attached to the Central Flying School from January 4, 1937, to undergo the forthcoming Instructors' Course.

Major Shintitch and Major Djordjevitch, of the Yugoslav Air Force, have been attached to the Central Flying School from January 4 in order to undergo a short course of five weeks.

Engineer Lt. K. Okuda, of the Japanese Naval Air Service, is attached to the R.A.F. Station Halton, from February 1 to 20, and to the Royal Air Force Station, Manston, from February 22 to March 17, in order to study the organisation of the work.

FLYING ACCIDENT

The Air Ministry regrets to announce that an aircraft carrying Sub-Lt. C. E. Lake, Lt. R. W. MacDonald and Telegraphist W. H. Currie, and belonging to No. 821 (Fleet Spotter-Reconnaissance) Squadron has been reported missing over the Mediterranean since the morning of February 15. Sub-Lt. Lake was the pilot, and Lt. MacDonald and Telegraphist Currie were the passengers.

Extensive search both from the air and by surface vessels has revealed no trace of the missing aircraft and personnel. It must therefore be presumed, with regret, that the personnel reported as missing have lost their lives.

ROYAL AIR FORCE GAZETTE

London Gazette, February 16, 1937

General Duties Branch

The following Wing Cdrs. are granted the acting rank of Group Captain (unpaid) while employed as Deputy Directors at the Air Ministry (February 1):—C. E. H. Medhurst, O.B.E., M.C.; G. C. Pirie, M.C., D.F.C.

The following are granted short service commissions as Acting Pilot Officers on probation with effect from and with seniority of January 31:—L. M. Barlow, J. R. Birch, L. G. Bowler, A. M. Campbell, H. R. A. de Belleroche, D. J. Devitt, D. W. Edmonds, J. B. Garland, H. G. F. Gaubert, G. P. Gibson, J. Harrington, J. G. Hick, J. R. A. Jones, R. G. Knott, W. R. J. MacWhirter, G. P. Miers, F. W. Miller, E. B. Morse, G. T. Stanley, A. L. Taylor, J. G. Thomas, R. J. Wilson, S. P. Woollatt.

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—B. H. Becker, B. A. Chacksfield, J. V. C. Badger, A. F. R. Bennett, W. B. Murray, A. C. P. Carver, M. D. Thunder, J. A. P. Owen, R. G. Watson, M. A. Aylmer, N. C. Jones (January 15); P. H. Holmes, I. A. Scott (February 12).

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—J. J. J. Page (substituted for notification in the *Gazette* of October 20, 1936) (September 1, 1936); C. S. Cooper, J. W. Arney, T. M. Buchanan, N. B. R. Bromley, N. M. Hall, M. E. W. Scott-Mackirdy, F. O. Dickson (January 27).

Acting Pilot Officer on probation P. D. J. Strong is graded as Pilot Officer on probation (January 27); Sqn. Ldr. D. d'H. Humphreys is placed on the half-pay list, scale B (January 12); Flt. Lt. E. C. Lewis is placed on the half-pay list, scale B, from January 22 to February 4 inclusive; Flt. Lt. the Hon. E. F. Ward is transferred to the Reserve Class A (February 11); Flt. Lt. W. J. Kentfield is placed on the retired list (February 17); Lt. G. D. Anderson, R.N., Flt. Lt., R.A.F., relinquishes his temporary commission on return to Naval duty (February 1).

Equipment Branch

The following Pilot Officers on probation are confirmed in their appointments and promoted to the rank of Flying Officer (January 6):—B. O. Cannon, J. E. Garwood.

The following Pilot Officers are promoted to the rank of Flight Lieutenant (January 10):—W. A. Lee, B. S. Cartmel.

ROYAL AIR FORCE RESERVE

Reserve of Air Force Officers

General Duties Branch

I. N. W. Mackie is granted a commission as Pilot Officer in Class AA (February 16): F/O. E. C. Gordon is transferred from Class A to Class C (December 23, 1935); F/O. P. B. H. Home is transferred from Class AA(i) to Class C (July 20, 1936).

The following Flight Lieutenants are transferred from Class C to Class A on the dates stated:—H. F. Jenkins, A.F.C. (November 7, 1936); F. J. Bailey (November 27, 1936); A. G. Loton (January 22).

F/O. W. N. L. Cope is transferred from Class C to Class A (August 29, 1936): F/O. W. S. Coates is transferred from Class C to Class AA(i) (August 17, 1936); F/O. C. L. Milligan is transferred from Class C to Class AA(ii) (December 28, 1936); F/O. S. E. Bulloch relinquishes his commission on completion of service (January 14); A.P/O on probation N. M. Bayliss relinquishes his commission on appointment to a permanent commission in the Royal Air Force (February 1).

Equipment Branch

Sqn. Ldr. C. E. Norris, O.B.E., relinquishes his commission on completion of service and is permitted to retain his rank (January 28).

Medical Branch

The following Flight Lieutenants relinquish their commission on completion of service on the dates stated:—M. Clancy, L.R.C.P. and S. (November 15, 1936); L. O'Connor, M.B., B.Ch. (February 2).

AUXILIARY AIR FORCE

General Duties Branch

No. 602 (City of Glasgow) (Bomber) Squadron.—The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—A. V. R. Johnstone (November 3, 1936); J. R. Hawkes (November 28, 1936); J. D. Urie (December 21, 1936).

No. 603 (City of Edinburgh) (Bomber) Squadron.—P/O. G. T. Wynne-Powell is promoted to the rank of Flying Officer (January 10).

No. 605 (County of Warwick) (Bomber) Squadron.—F/O. D. L. Lloyd is promoted to the rank of Flight Lieutenant (November 28, 1936).

No. 608 (North Riding) (Bomber) Squadron.—P/O. G. W. Garnett is promoted to the rank of Flying Officer (November 14, 1936).

Accountant Branch

No. 503 (County of London) (Bomber) Squadron.—E. J. Smart is granted a commission as Flying Officer (October 9, 1936).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Wing Commanders.—J. B. Cole-Hamilton, to Headquarters, R.A.F., India, New Delhi; for Air Staff duties, 11.1.37. C. W. Mackey, to R.A.F. Depot, Uxbridge; for Administrative duties, 6.2.37. T. F. W. Thompson, D.F.C., to University of London Air Squadron; to command, vice Group Capt. F. H. M. Maynard, A.F.C., 8.2.37.

Squadron Leaders.—A. H. Flower, to Headquarters, R.A.F., Middle East, Cairo, Egypt; for Air Staff duties, 11.1.37. E. R. C. Hobson, D.F.C., to No. 6 (Bomber) Squadron, Ismailia; to command, 20.1.37. G. R. O'Sullivan, to Air Armament School, Eastchurch; for administrative duties, 7.2.37. A. R. Wardle, A.F.C., to D.O.I., Dept. of C.A.S., Air Ministry, 8.2.37.

Flight Lieutenants.—Q. W. A. Ross, to H.M.S. *Eagle*, 5.2.37. A. Franklin, to R.A.F. Station, Calshot, 31.1.37. J. R. S. Agar, L. H. Anderson, to No. 224 (General Reconnaissance) Squadron, Boscombe Down, 1.2.37. V. G. A. Hatcher, A.F.C., to R.A.F. Station, Duxford, 26.1.37. H. A. Constantine, to Central Flying School, Upavon, 5.2.37. D. B. McGill, to No. 5 Armament Training Camp, Penrhos, 4.2.37. W. Dickison, D.S.M., to Home Aircraft Depot, Henlow, 8.2.37. H. Little, to R.A.F. Station, Tangmere, 8.2.37. R. I. G. MacDougall, to Experimental Section, Royal Aircraft Establishment, South Farnborough, 4.2.37. R. J. Bennett, C. L. Dann, A. M. N. David, F. W. H. Hall, G. E. Peacock, and D. N. Kington-Blair-Oliphant, to Air Armament School, Eastchurch, 18.1.37.

Flying Officers.—W. G. Bannister, E. F. E. Barnard, C. H. Brandon, C. J. P. Flood, K. Gray, E. C. Harding, J. O. Hinks, A. H. Jarand, A. J. Kennedy, R. G. Prier, H. R. Tidd, R. A. E. Traill, G. A. Walker, I. H. D. Walker, D. E. B. Wheeler and J. D. Nelson, to Air Armament School, Eastchurch, 18.1.37.

Pilot Officers.—J. B. Burnett, J. H. Irvin, J. P. Owens, A. C. R. Thompson, to R.A.F. Station, Calshot, 31.1.37. J. L. Atkinson, C. B. Lamb, J. P. S. Smyth, A. E. Williamson, A. L. Womersley, to No. 224 (General Reconnaissance) Squadron, Boscombe Down, 1.2.37. C. H. Heber-Percy, A. J. Elliott, R. N. Lambert, to No. 801 (F.F.) Squadron, 11.12.36. J. J. E. Coats, J. Greenhalgh, J. A. C. Karran, J. G. Thompson, to No. 811 (Fleet Torpedo Bomber) Squadron, 17.12.36. M. R. Baillon, D. V. W. Francis, J. Rankin, E. L. Wurtle, T. S. Rivett-Carnac, to No. 822 (Fleet Spotter Reconnaissance) Squadron, 17.12.36. G. B. Andrews, to No. 1 Armament Training Camp, Catfoss, 3.2.37. D. E. Gillam, K. H. Savage, to No. 2 Armament Training Camp, Aldergrove, 1.2.37. P. H. Hamilton-Hall, to No. 4 Armament Training Camp, West Freugh, 8.2.37. O. R. C. Moseley, to No. 5 Armament Training Camp, Penrhos, 5.2.37. A. G. F. Cuningham, to Air Armament School, Eastchurch, 1.2.37. J. H. Sindall, to Home Aircraft Depot, Henlow, 6.2.37. R. A. Weeks, W. Riley, to Electrical and Wireless School, Cranwell, 9.2.37. J. C. Richards, J. D. Harris, K. G. Sharp, to Air Armament School, Eastchurch, 8.2.37.

Equipment Branch

Flight Lieutenant.—C. B. Horsfield, to Headquarters, R.A.F., Middle East, Cairo, Egypt, 22.1.37.

Flying Officer.—H. Stones, to No. 223 (Bomber) Squadron, Nairobi, 18.1.37.

Dental Branch

Flight Lieutenant.—J. E. Tyrrell, to R.A.F. Hospital, Aden, 24.1.37.

IN SEARCH OF GERMAN AND ITALIAN AVIATION—PART III

GERMAN PRODUCTION METHODS

Truly Amazing Organisation found in the Henschel Factory : Real Mass - Production of Aircraft

By CAPTAIN NORMAN MACMILLAN, M.C., A.F.C., A.F.R.Ae.S., F.R.S.A.

This single-seater dive bomber, the Henschel 123, is now in production for the German Air Force with a B.M.W. Hornet nine-cylinder air-cooled radial. It has a top speed of 220 m.p.h.

I AM going to say at once that I have never seen in Britain an aircraft works like that of Henschel Flugzeug-Werke A.G. Fundamentally it is different. A new plant—it started operations in October, 1935—it has had the opportunity to embody new ideas.

The earlier Henschel plant—founded at Johannisthal in 1933 for the purpose (as Direktor Hormel, who controls the new plant, explained with a smile) of learning how to design and make aeroplanes while the new factory was being planned and built—is now given over to the training of workers and apprentices. For the German aircraft industry appreciates (and this is important) that workers cannot be picked up anywhere and thrown into the air craft trade without jeopardising both workmanship and output. Henschels, therefore, train men drawn from other trades before passing them to their main factory. That was their method of dealing with the insufficiently skilled labour difficulty when they first began to make aircraft in a country where aircraft had not been built in numbers since 1918.

This method could be applied in Great Britain. Factories, not yet contracting to the Air Ministry and requiring work, could be employed as training centres for unskilled labour under an Air Ministry grant. Such a method would save the main aircraft and aero engine production industry from continually engaging and discharging men in the high proportion that now applies. And before factories start in the depressed areas, the training of men should begin, for skilled workers from those areas have already migrated in large numbers to aircraft factories in the South of England. In Britain, as in Germany, this problem cannot be left to solve itself.

Henschel History

To appreciate the size of the Henschel aircraft factory organisation and how it grew swiftly into what it is, one must first grasp what the firm of Henschel is in Germany. The Henschel works were founded in Kassel in 1810. Even earlier, Henschels had cast guns, and made clocks and manual fire engines. The Kassel firm became in succession makers of locomotives, steam rollers, motor road trucks and many other heavy engineering products. In and about Kassel they possess five factories. It was a natural step for them to enter the field of aircraft production, just as they had entered the motor lorry field before. They had the funds for the purpose, and needed no Government assistance in finance. Opportunity synchronised with the decision to create the Air Force of the Third Reich. The first step was taken early in 1933.

As their plans developed the Johannisthal plant became too small. Henschels bought an estate at Schönefeld, to the south-east of Berlin. There they laid out their new factory and aerodrome. The foundation-stone was laid on January 17, 1935.

The factory is designed in a series of self-contained, independent buildings with large open spaces of grass between. No two buildings are in line. Hostile aeroplanes, therefore, could not fly over a line of targets. The whole factory is claimed—and, I believe, with justification—to be as difficult a target for destruction by air bombing as possible. A fire in one building will not affect another. There are no confined areas in which gas could hang about. The destruction of one unit will not affect the efficiency of others.

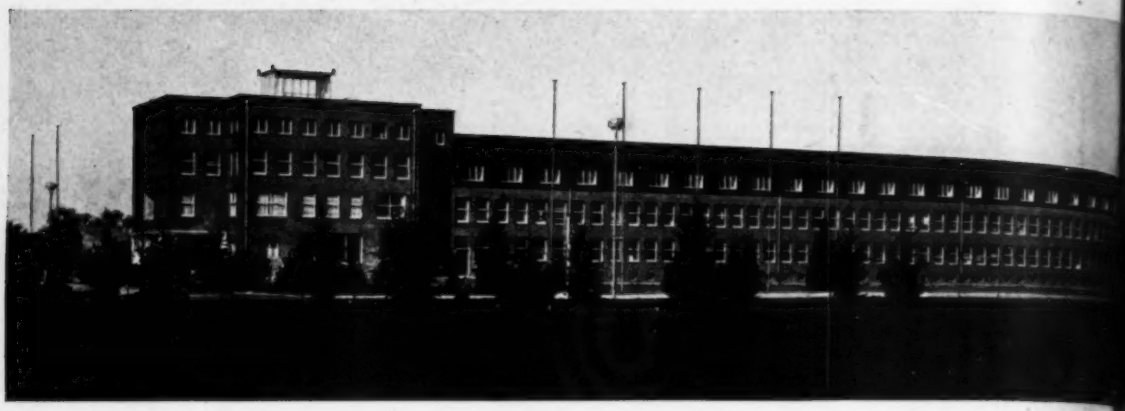
Independence for Safety

Each unit of the factory possesses its own independent water, power, heat, lighting supplies and canteen. Each unit has bomb-proof shelters beneath the building, able to accommodate all the employees in the section. The shelters have gas locks to prevent the ingress of poison gas. They are equipped with first-aid dressing stations, gas respirators, fire-fighting equipment; food, heat, light and water supplies and sanitation. Every employee knows his emergency station.

Yet when I suggested the necessity for such precautions in a British aircraft factory not long ago, its chief just laughed! Henschels don't laugh. They are prepared to meet any eventualities, for in Germany the lives of skilled workers are held to be as important as the lives of soldiers. Why have so many people in Britain failed to grasp the meaning of totalitarian war? Why does the Air Ministry not act? Perhaps the answer lies in another department—the Treasury.

Come with me as I walk over this remarkable aircraft factory, section by section, in the company of a technical official from the Air Ministry and a representative of Henschels.

First, we enter the administrative building, a fine modern structure designed on plain, practical lines. Right at the top we emerge into an observation room on the roof. It is square, with glass windows all round, rather like the bridge of a modern liner. Outside it an open terrace gives additional space from which to survey the expanse of flat



country surrounding the factory. From this point of vantage it is instantly clear that the irregular placing of the buildings over a wide area (the buildings are 200 to 250 metres apart) presents a new problem for aerial attack. The factory could not be destroyed in one attack without an overwhelming force of aircraft. Even then the aircraft would get in each other's way. The employment of a smoke screen might nullify an attack completely, for the pilots and bomb-layers could not tell where any building lay beneath it. The proportionate area of roof to ground is so small—the fenced-in area of the factory grounds is 150 English acres—that the odds against a blind hit are enormous.

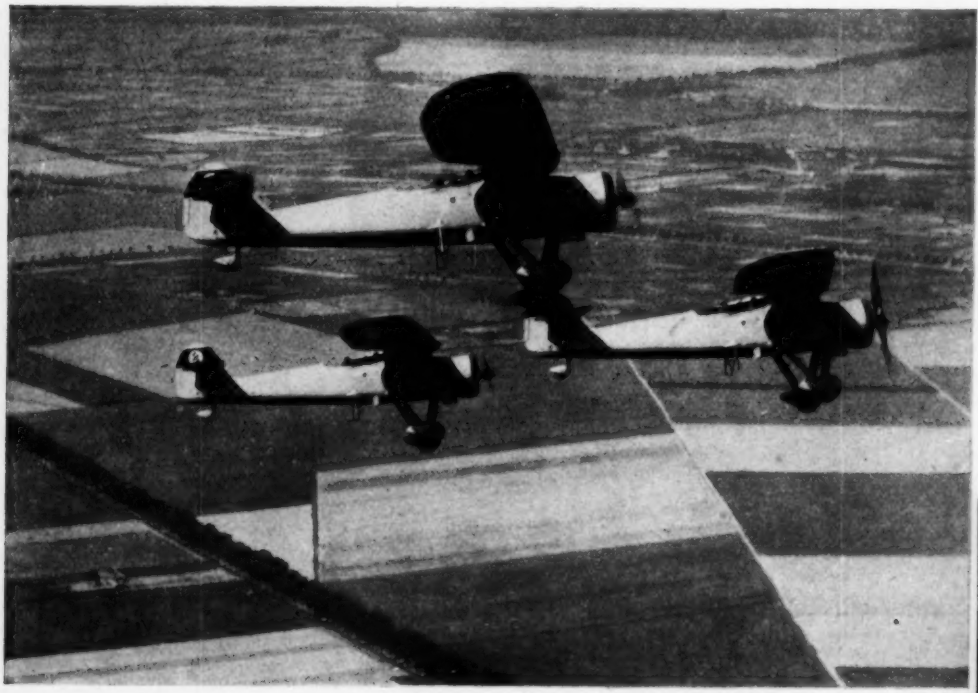
We walk downstairs and pass through a long corridor, on both sides of which draughtsmen are at work. Their drawing boards are mounted almost vertically, and counter-balanced so that the height can be quickly altered. The tees and squares are suspended for easy adjustment. There is no back-bending over these boards. They give great economy of floor space in comparison with the usual British drawing office with its almost horizontal boards. The drawing office runs the full length of one floor of the main building. I should say at a guess that it employs more draughtsmen than does any British aircraft factory.

We pass downstairs to the test department. There a metal wing is being statically loaded for test to destruction; engine mountings are shimmying under vibration tests; innumerable smaller parts are being dealt with, each in its particular way; a metal fuselage, already buckled under static test, stands on one side of the shop.

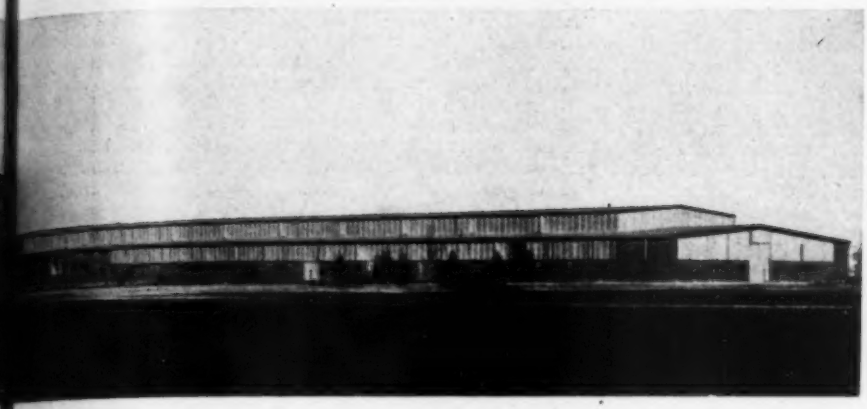
In the next department, where the strengths of the materials employed are checked, the standard methods common to engineering practice throughout the world are employed.

Beautiful examples of light alloy work, all made by machines, form an exhibit in the sheet metal shop. Five years ago many of the specimens exhibited would have been impossible of manufacture; to-day all the examples shown are processed regularly in the Henschel Works, many by special Henschel tools and methods, some of which have been adopted by other German manufacturers.

As far as I could see and learn there is less official control in the German aircraft factories than in our own. The companies conform to the rules laid down in the new Germany for all industry, but they do not appear to be subjected to the officialdom *versus* management struggle



A flight of reconnaissance machines, the Henschel Type 122, which form part of the equipment of the new German Air Force. The engine is a Siemens nine-cylinder air-cooled radial. Rolls-Royce Kestrel engines have also been fitted experimentally.



The Administration Building Note the observation room on the roof. The square-ended part of the building on the left houses the executive and the staff canteen. The drawing office runs the whole length of the second floor of the long wing to the right of the executive end. The shops at the far end include the central material test and inspection departments, the machine shop and the sheet-metal shop.

that affects the output of British factories. I understand that when one of the German factories invents a new process that accelerates production and the Air Ministry says it must be employed by other firms for the benefit of the State, the companies concerned are allowed to get together and conclude their own commercial arrangements. From all I saw I believe that the alleged repression of Nazism is mythical so far as the aircraft industry is concerned. If it were true, how is it that Germany has forged ahead with her aircraft and air force while we (with our democratic freedom) have reached a state which a friend of mine suggested would require two years in which to "disorganise the organised muddle"?

Sheet-metal Working

In the Henschel sheet-metal shop only light alloys are worked, so steel tools and dies are not required. Zinc is the material fashioned by the tool-makers. The zinc blocks are easier to work than steel, cheaper, just as effective, and when finished with can be readily melted down to provide new blocks.

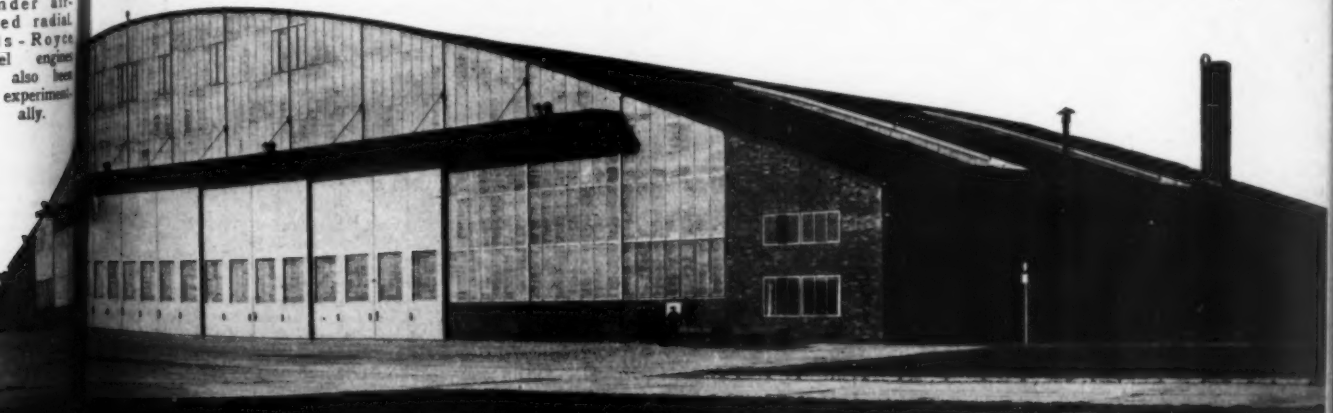
Some of the parts for the cross-members of wings, fuselage, tanks and bulkheads are made by drop-hammers. The metal sheet is placed above the die on the hammer bed and a sheet of heavy rubber laid on top. The hammer falls, its blow resounds throughout the shop, and after a brief series of blows the shape required has been created; the rubber prevents the soft metal from being over-extruded.

Next, let us look at a specially devised Henschel process for forming large rounded surfaces, such as those for cowlings and tanks. In the past it has been often necessary to have these spun or hand-beaten. Henschel designed an hydraulic machine to do this work. The hydraulic mechanism lies beneath the floor. On top of the machine is mounted a wood pattern, cut to the inner form of the shape required. The sheet to be worked is passed over the pattern block and clamped at either end to the fixed frame of the machine. The mechanic in charge operates the power control, the hydraulic ram extends, and the sheet metal seems to flow into shape before one's eyes under the upward pressure of the ram. The speed with which this operation is carried out is astonishing, while universal adjustments of the moving portion of the machine tool allow for wide variations in design. This tool has been adopted by other German firms.

We leave this shop and walk along a concrete road that runs through garden-like surroundings to the corrosion-proofing plant. The parts we have just seen being made in the machine and sheet-metal shops for internal details are suspended in electric baths charged with chemicals. They emerge a beautiful golden colour, with a perfectly smooth surface, proofed against corrosion. Colour can be varied by changing the chemicals. Thus, when required, wing parts or fuselage parts can be given a different colour for rapid identification. The bath adds a skin finish, not an impregnation. I was told this finish does not flake or wear off. The chemicals used are secret.

Thence we pass over another roadway to the assembly

One of the factory units. Each unit is a self-contained factory with its own heating and lighting plants, coal and water supplies. There are bomb-proof cellars fitted with gas filters under each building. The structure is designed on a "cut girder" principle so that a bomb bursting within will not bring down the whole roof.



plant. In one huge shed the fuselages of Junkers Ju.86 twin-engined bombers are being assembled. The parts flow in at one end of the shed and from the other emerge as completed fuselages. There is no haste evident, yet every man is working. Each detail of the structure proceeds smoothly without loss of man-hours, and as we pass along the length of the shop the fuselages grow before our eyes to the accompanying hum and chatter of pneumatic drills and riveting tools. Every part is jigged. There can be no mistake. Each finished unit is standardised.

In a similar shed some 250 yards away the wings are built. First the two spars are assembled on jigs, with their main tubes (that we had seen being milled for lightness in the machine shop) clamped securely into place. The secondary members are attached, and out of the jigs the spars go on to the main wing assembly plant.

Here again is a special Henschel layout. At first glance it looks like a shipbuilding yard. The wing assembly jigs—big, heavy steel frames that rise in a methodical row—are vertical structures in which the wings are built standing on edge. Platforms enable the mechanics to reach every part. The economy of floor space by comparison with the older method of building the wings on horizontal table-like jigs is obvious, and the continuity of work from section to section is perfectly synchronised.

The battery of steel frames rises from the concrete floor, each unit clamping its wing spars in place. The cross-members fall into their appropriate positions and are secured. The metal outer covering is riveted on. Except for a few main details in steel that bear the grey colour of cadmium protection from corrosion, all the internal parts are of the beautiful golden finish.

At a parallel line of benches mechanics prepare the detail work for the main assemblers. From jig to jig we pass between benches and growing wings, looking up at the workers on the platforms above our heads.

Real Mass-production

That line of growing Junkers wings is the most impressive thing I have ever seen in aircraft manufacture. For the first time I was observing real mass-production methods applied scientifically to aircraft construction. And that battery of jigs, so impressive in its layout, is designed for universal purposes, not solely for the output of one type. A change can be made to produce a different type of aircraft in twenty-four hours, I was told.

On the other side of the shop engine nacelles for the Jumo 205 diesel engines were simultaneously in course of assembly.

Again we walk along the concrete roadway to yet another shed. In it we see the complete assembly of the Henschel type 123—a single-seat dive bomber. In this shop both fuselage and wings are built, for the size of the aircraft is much smaller than the Junkers 86. Powered with a single B.M.W. Hornet air-cooled radial engine, the Henschel 123 has a top speed of about 220 miles an hour. It is designed to have a terminal dive of 350 m.p.h.

After the assembly of the Ju.86, that of the smaller Henschel 123 is less impressive, but here again order and method combine to produce aircraft quickly from the parts that flow steadily from the machine shop and elsewhere.

Thence along the concrete road we pass to the fitting-out shop for the big Ju.86 bombers. It is another large hangar. A battery of ten wing-mounting jigs stand in line fore and aft. Ten pairs of wings spread out from them, mounted by the standard Junkers system of screw joints. Their attachment is four-point, with one joint at the top and bottom of both front and rear spars. As the line moves forward to completion, engines and nacelles are fitted, electric wiring run, retractable undercarriages mounted and the unions connected up. The jigs run on rails, cable-towed, so that the line need never be empty while the other shops continue to feed it. Here the aeroplane takes all but final shape, for a double row of fuselages is being fitted out simultaneously with the wings, complete with gun turrets, the lower one of which is retractable within the fuselage.

Thence to the last shop, where wings meet fuselage and are mounted into place. Overhead cranes are available for transportation about the shed. Final inspection is made, and the completed aircraft pass to the test pilots.

Flight Testing

Out on the aerodrome stands a line of aeroplanes waiting their turn to take the air. It is a big aerodrome—441 English acres—with an excellent level surface. The clouds are low—about 800 ft.—but one after the other, heavy and dive bombers, are climbing from the ground to pass their flight acceptance tests. On the concrete apron between the shed and aerodrome stand other lines of new aircraft awaiting their turn to fly—mostly Ju.86s, but with a few Henschel 122s and 123s as well.

By the use of calculating machines the complete costing and wages cards are handled by a staff of only twenty. As I sat in the administration building canteen and ate the excellent standard lunch provided for all throughout the factory, I realised that Henschels, the century-and-a-quarter-old firm of locomotive builders, had solved the problem of the swift production of military aircraft. And while I ate I heard the peculiar drone of twin Jumo 205s as, out on the aerodrome, their testing went steadily on.

I have not indicated in this article what I imagine the probable output of this factory to be. Nor have I stated the number of aircraft I saw on the aerodrome. The reason is clear. I visited Henschels' aircraft works by courtesy of the Reichsluftfahrtministerium, and I believe that a guest should observe discretion in courtesy to his host, even though I was told that I could write upon all I saw.

[*In the next article in this series Capt. Macmillan will describe the Daimler-Benz engine factory and the air museum in Berlin.*]

AIR STRATEGY

Air Strategy. By Lieut. General N. N. Golovine (in collaboration with a technical expert). (Gale and Polden, Ltd., 7s. 6d.)

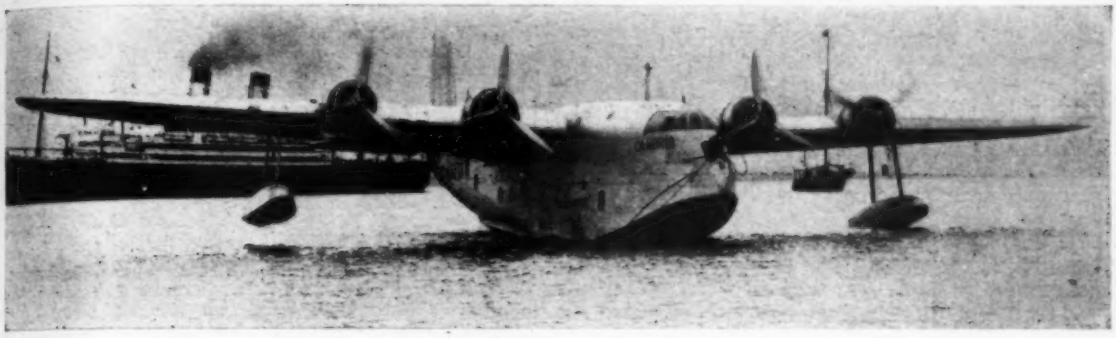
THIS distinguished writer preaches on the text that in organising an air force every country ought to consider the strategical doctrine according to which its force will be used in war, and should equip its squadrons accordingly. He starts by examining the writings of the Italian General Douhet, which, he says, represent one of the first, and certainly the most important, attempts to form a complete "air doctrine." The Italian writer holds that in modern warfare the Army and Navy cannot obtain rapid and decisive results, but that an air force can do so. He also shows a marked contempt for anti-aircraft defence, and on this point General Golovine joins issue with him. He believes that air attack is by no means certain to overwhelm air defence.

The author then proceeds to examine the air problem as it confronts Great Britain, and makes suggestions for the different branches of the R.A.F. which he considers necessary. It is, he says, a threefold problem: (1) defence of the British Isles, (2) defence of the Dominions and Colonies, and (3) protection of Imperial routes. He pays most attention to the first, but would divide the R.A.F. into an I.A.F.S.O. (Independent Air Force for Strategic Offensive), and an I.A.F.S.D. (Independent Air Force for Strategic Defence), the latter to include all the anti-aircraft organisation.

It would be impossible to follow all the arguments of this author in a short review, but it may be noted that he considers massive air raids on large cities practically impossible and their cost prohibitive, that he would introduce what he calls "destroyers," *i.e.*, multi-seater long-range fighters to engage the raiders at a distance, as well as single-seater fighters for defence round the cities, and that he believes in scouting aeroplanes to locate the line of approach of raiders when still at a distance from our shores. One may not agree with all his proposals, but Gen. Golovine's book certainly deserves careful study by all who are interested in the problems of air warfare.

COMMERCIAL AVIATION

— AIRLINES — AIRPORTS —



LONG-RANGE EXPERIMENT : Following *Caledonia's* non-stop flight from Southampton to Alexandria, the second long-range Short boat, *Cambria*, made a circuit of Britain last Sunday. This photograph shows *Cambria* being moored off Hythe at the end of the flight, with the liner *Westernland* in the background.

THE WEEK AT CROYDON

British Airways' Home-from-Home : Exhibits and Ideals : D.C.2 as Tender

BRITISH AIRWAYS, still exiled by the Gatwick moisture, are settling down here nicely and operating their services with regularity. Three of the oldest members of the original Hillman Company, that gallant pioneer effort, are here with the B.A. contingent, Capt. Pelly, Mr. van Oppen, and Mr. Flowerday. The last-named has the job of instructing on the new British Airways Junkers, and the other day some of his pupils presented him with a dissolute-looking mortar-board. Those who visualise him wearing it in conjunction with a pair of "specs" on the tip of his nose will see the likeness at once.

T.R.H. the Duke and Duchess of Kent flew to Paris by Imperial Airways last Saturday, and thence inwards also on the same route came Mr. Winston Churchill, who asked a number of shrewd questions of his pilot, Capt. Horsey. Unlike the average politician, Mr. Churchill has a grasp of what is essential, and spotted the danger of private owners without wireless careering round the place in QBI. It might be a good idea to mention to him the absurd situation into which we are drifting regarding Gravesend, whereby that vitally important emergency landing ground may shortly become a bristling mass of roof tops and commercial aeroplanes with an hour or so to wait just outside the control zone, will either have to return to their port of departure on the Continent or else roost on wayside trees like disconsolate crows.

As expected, the opening of the R.I.B.A. Airports Exhibition last Friday was a jolly gathering, mainly of those vaguely connected with the more abstruse aeronautical side lines which seem to allow of infinite leisure to attend such functions. To the very few really practical people present it appeared that nobody was quite sure exactly what really was needed in the way of a place of arrival and departure for aeroplanes. I did not notice, for instance, any particular grasp of the idea that a terminal airport has different needs to a transit airport. At the one, journeys just begin and end, but at the other design should clearly follow the need for quick departure again for a further destination, with all that it implies. For example, speedy refuelling, without wandering from the platform, is essential for both man and aircraft, and there is no opportunity to admire the pretty flowers in the garden outside the secluded bar about half a mile from the tarmac apron when time on the ground is limited to a short fifteen minutes.

Last Saturday morning a K.L.M. Douglas D.C.2 flew direct from Amsterdam to Eastleigh Aerodrome, Southampton, to transfer passengers for America to the *Europa*. Among them was Mr. A. Plesman, Royal Dutch Air Lines' managing director. On the way back to Croydon the machine circled over the *Europa* in salute. Next morning the visit was returned, when at about 8 a.m. the flying boat *Cambria* flew over Croydon and then proceeded on her 1,300-mile cruise around England with Capt. G. J. Powell in command.

Swiftly from Erin

Irish Sea Airways, Ltd., ably assisted by a strong tail wind, made a remarkably quick trip one day last week from Dublin to London, 309 miles, in 87 minutes with seven pleased passengers. The pilot was Capt. Stoney, who, incidentally, is an Irishman. Another typical son of Erin on the same route is Capt. Armstrong, who has just returned to duty after three weeks' leave. It is interesting that Irish Sea Airways' services are running with loads which are not at all bad for winter time—and, what is more, for the first winter of operation.

K.L.M. reports that already several Indian Maharajahs have booked air passages to Europe for the Coronation ceremonies, filling with their suites whole machines at a time. Amongst them are the Maharajahs of Jodpur and Kashmir and, I believe, the Maharani of Cooch Behar.

Interesting is the innovation of "no passport" week-end tickets by air to Holland. This system has been in force on the Paris and other lines for some time, but not to and from Holland until recently, when K.L.M. secured this privilege. Talking of passports, Mr. Cripps, that emigration officer so well known at Croydon and Gatwick, who so happily blends geniality with sternness when performing his duties, is being transferred to Harwich.

Surrey Flying Services, Ltd., had a Press special to the railway accident near Cranwell, when both air and ground photographs were taken. Mr. Alexander, the pilot, con-

trived to arrive back at Croydon just as dusk fell.

Last Friday the annual Airport dinner and dance was held as usual at the Greyhound Hotel, Croydon, where 180 people sat down under the chairmanship of Air-Commodore Robertson, C.B., D.F.C., chief aerodrome officer. A number of late-duty people came along afterwards and made up for lost time. The onerous duties of M.C. were nimbly performed by Mr. Joe Chamberlain, under whose stern eye nobody dared hiccough above a whisper.

A. VIATOR.

Towards Manila

ON January 9 the Java-Borneo service operated by K.N.I.L.M. was extended to Tarakan. This is the last station on the projected Batavia-Manila route. Mr. Plesman has recently sailed for the U.S. to discuss the final link.

Another Entrant

WHILE we await the organisation of a British South Atlantic service, for which a subsidy is already virtually available, Italy has, it is reported, been carrying out negotiations with the Brazilian Government on the matter of an Italian air service to that country.

Back to School

AFTER a number of weeks of expectation " Jimmie " Jeffs has now moved to the Air Ministry for a short spell in C.A.4 before taking over his school for control officers at some unnamed airport.

The chief officer at Heston is now Capt. J. P. Morkam, who was senior A.O.2 at Croydon and has served that airport and Lympne in responsible positions since 1923.

To Nigeria By Air

AÉROMARITIME are to start their new service along the Gold and Ivory Coasts from Dakar on March 1. Through bookings from London can be made with Air France, whose weekly service to Dakar will make connections.

Leaving London on Saturdays at 10.30, passengers will fly to Toulouse by the new service via Bordeaux, arriving at Toulouse at 13.50 hrs. Toulouse-Dakar is flown during Sunday in Dewoitine 338s, and on Monday passengers transfer to a Sikorsky flying boat of Aéromaritime reaching Zigwinchor and Conakry that day. On Tuesday Monrovia and Abidjan are made, and on Wednesday Takoradi and Contonou.

Arrangements are being made for Lagos (Nigeria) to be reached on Wednesday afternoon by a feeder service. On the return journey Cotonou is left on Fridays and London is reached on Tuesdays.

The Eternal Flame

AN interesting flare device for aerodrome use is being tested at Heston. A U.S. patent, it burns for forty-eight hours at a filling, is unbreakable, self-righting when upset, and stays alight in all weathers. The Toledo torch, as it is called, is bomb-like in appearance and extremely solid in build. It has hitherto been used mainly for the lighting of road works, but it appears likely to have outstanding advantages for aerodromes. The usual flares used for marking out landing paths on non-floodlit aerodromes weigh about 25 lb. and must be lit, one by one, as they are placed in position. The Toledo torches, on the contrary, weigh only about 6 lb. and may be lit and carried out, already burning, on a lorry or truck. There is no need to stop the lorry to place one in position. It can just be chucked out, and should theoretically alight unbroken, right itself and remain burning.

Empire Air Mail Exhibition

OPENING on the same day as the British Industries Fair, the first Empire Air Mail Exhibition did not, perhaps, gain as much publicity as it might otherwise have done.

It was held last week on the fourth floor of Selfridge's, Oxford Street, London, and a number of collectors showed stamps and other souvenirs of air mail history from the time of the world's first official aeroplane mail, which took place within the Empire—a flight of a few miles from the grounds of the 1911 Allahabad exhibition.

The organiser of the flight, and of the Coronation air mails in England a few months later, was Commander Sir Walter Windham, R.N., now president of the Air Mail Society, which planned the Exhibition.

In addition to the displays from private collectors, a number of dealers had stalls, and they made an interesting display from the available material. As always on these occasions, the absence of any air stamp from the British Isles was notable by contrast with the varied issues of the Dominions and other overseas parts of the Empire.

Jersey's Airport

THE opening of the new Jersey airport has been fixed for March 10, and the services will operate from the beach for the last time on that day.

So a common object of the St. Helier beach will depart to green pastures. The castle-building community will probably burn a D.H.86 in effigy on the day when they regain their freedom, but people living on the seafront are likely to miss the familiar spectacle. However, tidal timetables will be abolished, and the skill of pilots need no longer be exercised on cross-wind landings. Three years of beach landings under the noses of the travelling community has been an advertisement which will be difficult to replace.

A Canadian Merger

LEIGH BRINTNELL, president of Mackenzie Air Service, which operates mainly in the Mackenzie River basin, has announced that this company, Wings, Ltd., and General Airways have merged to form United Air Service, Ltd.

Wings, Ltd., serves mainly Manitoba and north-western Ontario, while General Airways has been operating chiefly in eastern Ontario and Quebec. The new company will thus operate on a Canada-wide basis.

The reasons for the merger were not given, but the trans-Canada airway mail contracts are seen as the main reason, since Canadian air operators are all endeavouring to obtain a major slice of the mail which will be carried, starting this summer, from Halifax to Vancouver.

The Gravesend Business

GRAVESEND, a vitally important alternative airport on one of the busiest of routes, may be closed down and used for building.

The importance of Gravesend lies in the fact that it is directly on the track of machines flying from Northern Europe. It is, moreover, just outside the Croydon controlled zone. Increasing air traffic and the tendency of air services to bunch at peak periods of the day mean that a pilot over Gravesend may be told that his landing turn at Croydon is number five.

Thus, four other pilots are to land before him, and as each is allowed fifteen minutes he has an hour to wait in bad and possibly deteriorating weather conditions. Several companies, consequently, have an arrangement whereby Gravesend can be used and passengers dispatched therefrom by road to London. A further, and universally beneficial result, lies in the relief of traffic congestion around Croydon.

Days occur, also, when there is no chance of reaching Croydon, but when services may be maintained because such ports as Gravesend are clear.

That Gravesend is vitally necessary as an emergency airport admits of no argument. In fact the following remarks appeared in *The Report on the Progress of Civil Aviation, 1935*: " Early in 1933 it became evident that additional aerodromes were required . . . to afford relief to the main airport at Croydon on occasions when that aerodrome was affected by conditions of bad visibility. It was clear that at least one large subsidiary aerodrome outside the fog belt was required to cater for German and Netherlands aircraft entering the country *via* the Thames estuary, and another for aircraft arriving from Paris *via* Bexhill."

Gatwick and Gravesend, both privately owned, were mentioned in the following paragraphs, and it was stated that a fifteen-year agreement had been arranged whereby the owners would maintain these airports in a manner adequate for the purpose. The owners did so.

Air routes do not consist of a couple of terminals, and lines of communication must obviously be maintained throughout their length. Blandly to permit the disappearance of the part of an air route as vital as Gravesend is ridiculous.

Attractive though it may seem to ask the foreigner to subsidise the airport in question, the principle is a dangerous one, for British firms operating abroad may find themselves paying heavily for the same essential facilities.

In any case, if the need is apparent now, how much greater will it be in subsequent years, when unprecedented air transport expansion may be expected?

PREPARING FOR THE ATLANTIC

Remarkable Flights by "Caledonia" and "Cambria" : 2,300 Miles in Eleven-and-a-half Hours

A NON-STOP flight from Southampton to Alexandria—a matter of 2,300 miles—was accomplished on February 18 by the Imperial Airways' flying boat *Caledonia*, one of the two boats designed for the Atlantic. The machine left Southampton Water at 4.15 a.m. and put down at Alexandria, after a non-stop flight, at 5.50 p.m. The average speed for the flight was 170 m.p.h. Since the distance is actually several hundred miles longer than that from Ireland to Newfoundland the flight can be considered as a genuine test.

Caledonia carried a crew of five, consisting of Capts. W. N. Cumming and A. S. Wilcockson, First Officer W. L. Garner, Radio Operator Stocker, and his assistant, Mr. Burden. At Alexandria, incidentally, the operators on *Cassiopeia* kept in touch with *Caledonia* during the entire flight. Nothing wrong with *this* radio equipment.

Three days later, with Capt. G. J. Powell, another of the Atlantic experimentalists, in command, *Cambria* made a non-stop circuit of Great Britain.

The route, covering more than 1,300 miles, included London, Great Yarmouth, Grimsby, Whitby, Berwick, Edinburgh, Glasgow, Belfast, Dublin, Swansea, Taunton, and Southampton, which was also the starting point. The new radio station at Foynes, Co. Limerick, was in action during the trip, on which the weather, generally speaking, was good. Glasgow, however, was fog-bound and there was rain over the Irish Sea and Wales. The journey was completed in 8 hr. 42 min. at an overall speed of 135 m.p.h. Other members of the crew were First Officer E. N. Gurney, Flight Engineer E. J. Crowson, and two radio operators, Messrs. Dangerfield and Lancer. Sqn. Ldr. E. H. D. Spence, of the Air Ministry, and Mr. Burton, of the Marconi Company, were also on board as "observers."

One or other of the boats will shortly fly over to the Shannon, where instructions have been given that the estuary should be kept clear. Special out-and-home Atlantic experimental flights will be made during or after May.

Portsmouth Back Again

FOLLOWING the offer of better terms by the Air Ministry, the Portsmouth Docks and Airport Committee has decided to proceed with the original barrage scheme for Langstone Harbour. The latest offer—a contribution of 50 per cent. of the cost, up to a maximum of £600,000—means that only 3d. will be added to the City's rates.

Amsterdam, Lisbon and Angola

REPRESENTATIVES of K.L.M. have, we understand, been in Lisbon discussing with the Portuguese authorities the possibilities of an air service connecting Amsterdam, Lisbon and Angola, the Portuguese colony in West Africa. These representatives have given the impression that the service will be working quite shortly.

From information available it would appear that the service will include a non-stop run between Paris and Lisbon—an Amsterdam-Paris schedule is normally operated. This non-stop section would certainly mean a considerable reduction in pay-load.

The African section does not appear to have been finally planned, but provision may be made for an extension from Port Etienne to the Cape Verde Islands and so on to South America.

So far the whole idea is in the air, but one cannot help thinking that Portugal must be a difficult country to fly to, over, or through. Air France actually secured a monopoly of air traffic there, but the scheme fell through for various reasons. Imperial Airways (with Pan-American Airways) have been discussing the use of Portuguese territory for years, with no results that are visible or invisible. Then Mr. Crilly actually got as far as inaugurating a London-Lisbon service. Finally, the Germans had a try; they had better luck. As the outbreak of the Spanish Civil War in July, 1936, rather spoiled Seville as a terminus for their Transatlantic service they were compelled to adopt Lisbon as the European terminal, and with such apparent success that it is quite on the cards that Lisbon will supersede Seville when, and if, the Spanish trouble comes to an end.

A Veteran Departs

THE fact that a D.H. Dragon G.-ACFG has just been sold—to an Australian company, we believe—may not be very interesting news. This, however, of all Dragons, has had a more than usually eventful career—though Dragons, as the first large machines to pay their unsubsidised way, are always eventful.

This particular D.H.84 was built in 1933, finished fifth in the King's Cup race of that year (pilot Hubert Broad) and was bought by an Italian count, with whom, apparently, she travelled to Vienna, Belgrade, Bucharest and Constantinople.

In 1934 she was purchased by Mr. George Nicholson to operate his Northern Airways' service between Newcastle and the Isle of Man. When Northern and Scottish Airways was formed by him in November of that year, "FG" came over from Renfrew to start the services, and was used for the inaugural Skye and Hebridean flight. Her log-book shows some 130,000 miles. Let us hope that she flies another 130,000 miles in Australia—or wherever she may be.

High-pressure Airscrews

UNDER the above title a private company was registered on February 18, with a nominal capital of £10,000 in 10,000 shares of £1 each. The object of the new company is to acquire certain patent rights in connection with v.p. airscrews, and to adopt an agreement with E-H Engineering, Ltd. There shall be two Hawker Siddeley directors on the board, Messrs. H. K. Jones and H. N. Wylie having been appointed.

The Esher Trophy

AFTER a Yorkshire Squadron the Middlesex Squadron was the next best thing Lord Swinton (who was once an M.P. for part of Middlesex) admitted as he presented the Esher Trophy to Squadron Leader C. P. Gabriel last Wednesday evening in the squadron hangar at Hendon. Last year was the first year in which Sqn. Ldr. Gabriel commanded No. 604 (County of Middlesex) (Fighter) Squadron, and it does him infinite credit that his assumption of command should have been followed by the winning of the coveted Esher Trophy, which labels the squadron as the most efficient of all the auxiliary squadrons for the year. This is the second time that No. 604 has won the Esher, the last occasion having been in 1932.

A very distinguished company attended the ceremony, among whom were Sir Samuel Hoare, Hon. Air Commodore of the Squadron, and Air Marshals Sir Hugh Dowding, A.O.C. Fighter Command, and Sir Frederick Bowhill, Air Member for Personnel. After the ceremony the C.O. and officers of the squadron were At Home in the officers' mess.

Compressed-wood Airscrews

A NEW development of the German Heine wooden airscrew blade described in *The Aircraft Engineer* of October 29, 1936, has been introduced quite recently. Originally only the wood at the blade hub was compressed (to fit into the metal sleeve of a v.p. hub), but now the whole blade has been successfully compressed, and airscrews with this type of blade have been tested at Adlershof, where they withstood stresses 35 per cent. in excess of the maximum to which they could possibly be loaded in flight. A great saving in weight compared with metal blades is claimed (about two-thirds). The sole licensees in Great Britain and the Dominions are Jablo, Ltd. Brettenham House, London, W.C.2.

Incidentally, it is stated that the recent agreement in Germany between the Heine and Schwarz companies concerns solely the soldering of gauze to metal for the leading edge of airscrews, and does not in the least affect the position in this country.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for publication in these columns.

LIGHTS UNDER BUSHELS?

I HAD the pleasure of listening to Mr. Fedden's lecture on the Trend of Air-Cooled Aero Engines. Along with others I went specifically to hear what was thought would be a very interesting lecture and a rousing discussion. The indications for a good discussion were (1) that Mr. Fedden was asking for advice from the aircraft people and proffering some to the engine people; (2) that he is rather dogmatic in his statements, and usually very pro-radial and air-cooling. Which one expected would again arouse the in-line air- and liquid-cooling camps.

We heard the good lecture, but did we hear a good discussion or any helpful advice from an audience of approximately 300, representing the brains of the aircraft industry? No, sir! Only one aircraft man had anything to offer and that was apparently known to Mr. Fedden; the rest just failed to utter a word. The in-line and rival radial camps had not a word to say, despite the slight which Mr. Fedden had given them by saying that we had nothing in this country between the Gipsy VI and his own engine sizes. The liquid-cooling people were also silent.

So when Major Green made the insinuation that all the best brains in the country are at Filton, one was inclined to agree that this is so, or else that the other engine camps are either not capable of arguing with Mr. Fedden, or no longer have an argument against the radial engine. Or, on the contrary, must we accept the other view that it is the conservatism of the British people which prevents them giving anything away? They do not mind copying any ideas they can get from anyone else, but they just hate to let anyone know what they are doing. It's a great pity they cannot come out into the open as do the Americans; they might just as well do so, because there is no such thing as a secret in the aircraft industry.

This is the second lecture which I have attended where the lecturer has asked for information and co-operation from a learned body; the result has been the same on each occasion.

So if there are any other great minds, like Mr. Fedden and Mr. Ricardo, considering asking for advice from their contemporaries, let them be warned that they themselves are the only ones who will do any giving.

Further strength to my conclusions was lent by two foreign gentlemen who entered the discussion, despite the disability of a foreign tongue, and were the only people who had anything technical to discuss.

In conclusion, I would like to thank Mr. Fedden for a fine lecture and also for doing what so few people do now, that is, replying to the discussion verbally and without favour. I do regret though that he did not tell us a little about his very attractive sleeve valves, and compare them with the poppet valve.

F. GREAVES.

Hayes, Middlesex.

RELATIVE RELIABILITY

REFERRING to Mr. Steve Hill's letter in the issue of January 14 concerning the relative reliability of aero and motor cycle engines, I should like to add a few thoughts in support of the Editor's comment.

Until recently I have been a student of the College of Aeronautical Engineering, part of whose works are situated at that haven of speed, Brooklands. I therefore had the opportunity of observing the preparation and performance of all things that attempted to function in accordance with the "ideal Otto cycle."

First, I should like to declare that Mr. Hill has no grounds in estimating the failure of aircraft engines as being frequent. The extraordinary claims of certain aero engine manufacturers and airline companies prove that the failures that do occur are few and very far between. The few there are, especially when they are in connection with some stunt flight, always receive the full attention of the daily papers. Of these failures a certain number could be traced to the ignorance and carelessness of pilots (e.g., operation of altitude controls), and not to the ground engineer who signs for the responsibility of the correct functioning of the machine.

Mr. Hill may not be familiar with the duties and responsibility of a modern licensed ground engineer (or with the knowledge he possesses as compared with a garage mechanic), or even with the precautions, inspections and red tape that are attached to the maintenance of an airworthy aircraft; if he is, he will readily realise that the engineer cannot afford to take the responsibility of a man's life casually, and every safeguard and precaution (within the human element) must necessarily be taken.

During the last two years I have owned four road vehicles in all (each at different periods!), and in travelling from London to Newcastle, a distance of nearly 300 miles, I have always had to stop for some little thing, i.e., oil leaks, primary wire from coil breaking, radiator leaks, and so on. On one occasion, with a brand new motor cycle costing over £90, the throttle cable broke. The point is that these little mishaps could hardly be classed as engine failure on the road, but in the air they would be, a forced landing with a possible crash being the net result.

From a technical aspect the following cannot be overlooked. First, the factor of strength for a given weight hardly enters into the design of a road vehicle (even a racing motor cycle) to the same extent as it does in the aero engine. The parts of a racing motor cycle can be given a more than desirable factor of safety without appreciably affecting the performance. It must also be remembered that a motor cycle engine is a comparatively simple unit involving the minimum number of moving parts.

I cannot appreciate Mr. Hill's statement that the road vehicles he mentions have a harder time than the aero unit. After all, the two are each designed for a particular purpose. The aero unit has to contend with variations of temperature and pressure, bringing in ice formation in carburettors, variation of oil viscosity, variation of boiling point of coolant, mixture strength problems, air density, and so on, all of which are peculiar to its own purpose. As the Editor remarked, the aero motor runs at, maybe, 9/10ths full throttle for a duration of time that will increase the risk of oil leaks and fatigue failures, and I consider it to be nearer its stress limit than any lorry that is built like a battleship! A cavity or small nick in an aero engine con-rod is sufficient to scrap it, and, oh boy, have they got to be polished! The average aero engine, correctly serviced (which they have to be), seems to last almost as long as the eternal cargo boat. We change our modern cars every two years. Why? Because they are no longer reliable.

I do not know whether Mr. Hill considers that the motor cycle engine is superior because it can develop 37 b.h.p. from 499 c.c. But no fair comparison of b.h.p. per litre can be made between two different cylinder sizes, and an aero engine cylinder bore is generally between 4 and 6 inches with a consequently smaller surface-volume ratio. This affects heat loss and the highest useful compression ratio employable.

If Mr. Hill reads the requirements of a type test in A.P. 1208 he will not wonder why British aero engines have achieved such a fine reputation for reliability.

R. TOWERS.

Rochester.

FIXING THE FIXTURES

I WOULD like to suggest that the various organisers of flying displays and race meetings send you *now* the dates on which they intend to hold their meetings, so that entrants and demonstrators know roughly when they will be able to race or demonstrate if invited. Last season we had clashing fixtures, and in certain instances some of us were forced to give great displeasure by our not appearing.

I fully appreciate the fixture list issued by the Royal Aero Club, but this covers only the major events, and the minor, but equally important, events are sprung on us a week or two before they are due to take place.

The Royal Automobile Club issues, in January, a complete list of the trials, both major and minor, and an intending entrant knows the position for the year.

P. J. FIELD-RICHARDS.

London, S.W.6.

A Reading Appointment

COL. M. ORMONDE DARBY, of Rolls-Royce, Ltd., has been appointed to the Board of Directors of Phillips and Powis, Ltd., in succession to the late Mr. Arthur Wormald.

February 25, 1937. Supplement to FLIGHT 1983

The AIRCRAFT ENGINEER

"FLIGHT" ENGINEERING SECTION

No. 133 (Volume XIV No. 2) 12th Year February 25, 1937

THE FUTURE of the AIR-COOLED ENGINE

Mr. Fedden's "Five-year Plan" : Forecast of Most Likely Layouts : The Effect of 100 Octane Fuel : Diesel Engine's Place in the Scheme of Things

"At the present time 45 h.p. per cylinder is the limit which has been attained for air-cooled cylinders at suitable r.p.m. and to maintain really first-class reliability. It is, however, believed that this is by no means the limit for this type of cylinder and that in the next few years it may be expected that satisfactory air-cooled radials up to 1,000 h.p. and weighing under 2 lb./h.p. will be an established fact."

Thus Mr Roy Fedden spoke of the future more than fifteen years ago, as recorded in *Flight* of December 15, 1921. The sentence is quoted because it illustrates a fact which many may possibly have overlooked, i.e., that in addition to being an extremely successful aero-engine designer Mr. Fedden is also a prophet of high standing, even in his own country. When, therefore, he attempted to forecast the future in his lecture to the Royal Aeronautical Society last Thursday he did so against a background of previously fulfilled prophecies.

Mr. Fedden chose for his paper the title "The Trend of Air-cooled Aero Engines in the Next Five Years," and a large audience listened to him with an interest amounting almost to fascination. Following is a summary of the paper.

Mr. Fedden opened by explaining that since July, 1935, when he read his paper, "Future Research of Air-cooled Aero Engines," we had entered on a period of intense activity and development not fully envisaged at that date. A number of suggestions then put forward had been, or were in course of being, investigated by various Government Departments or interested firms, so he had endeavoured to write an addendum. He did not claim that the present paper was a highly technical commentary or a definite prescribed programme of what the immediate future might hold for air-cooled aero engines, but rather it was intended to put forward "feelers" to ascertain what might reasonably be accomplished within the next five years.

At least four years were necessary to develop an entirely new type of aero engine through its teething troubles to the production stage.

The day of the "general-purpose" engine, except for certain civil aircraft requirements, was fast disappearing Mr. Fedden suggested that that policy of putting engines into production at a comparatively low rating and of stepping them up as the necessity arose was a great deal more difficult to-day and would be impossible in the future.

Before attempting to analyse the layout of new engines Mr. Fedden thought it advisable to envisage the most important types of aircraft for which these engines would be required and approximately the speed and range expected of them. Several examples had been seen in recent years of perfectly good aero engines having been designed and built but filling no useful purpose because the designer had an incorrect original conception. Mr Fedden believed that the marked stepping up in performance of aircraft during the last few years must level out and gradually slow up, and would inevitably result in a somewhat longer period for new development He assumed that what he called the Douglas type (a clean low-wing monoplane of comparatively high wing loading, stressed-skin structure, retractable undercarriage, and cowled radial engines fitted with variable-pitch airscrews and mounted on the leading edge of the wing) would be continued for some considerable period in various forms, in larger sizes, and with a greater number of engines, and also in smaller forms—twin-engined types gradually replacing single-engined machines for all purposes.

Discussing the mounting of a number of engines on the leading edge of a wing, Mr. Fedden said that for the higher-powered categories, in order to obtain the necessary thrust for take-off, a low reduction gear to the engines and large-diameter airscrew would be necessary. This meant that the engines would have to be comparatively widely spaced. The necessary clearance for propellers of 1,500 to 2,000 h.p. with 0.35 to 0.38 reduction gear ratios must produce a serious problem so far-reaching and fundamental that it might actually affect engine design to the extent of a larger number of units being chosen for a given total horse-power by the aircraft designer, or, alternatively, two-speed gears in conjunction with controllable-pitch airscrews or double concentric airscrews.

It was understood that aircraft designers were awaiting the results of some important research work affecting wing sections. Wing loadings of 30 to 40 lb. might be expected, and speeds in excess of 400 m.p.h. might be envisaged without coming into the danger zone of the compressibility burble. However aerodynamically clean aircraft might become in the near future, speeds of this order meant a good deal of horse-power, and a considerable step up in the unit size of engines must be contemplated. It did not seem possible that stratosphere flying would become common practice within the period under review except for a few special military squadrons and possibly for experimental civil aircraft. Indications were that the engine designer would not have to provide for groups of engines geared to a single airscrew. It was suggested that the main aircraft categories might be divided up as follows:—

PROBABLE MAIN AIRCRAFT CATEGORIES.

Type.	Maximum Speed m.p.h.	Cruising Speed m.p.h.	Cruising Range.
CIVIL.			
Land machines ..	275	220	1,000–1,500 miles
Seaplanes	250	200	1,500–2,000 miles
Special category			
Long Range machines	250	220	3,000–4,000 miles
MILITARY.			
Destroyers	425–450	—	1½–2 hours.
Multi-seater fighters	400	—	1½–2 hours.
Medium bombers ..	—	300	6 hours.
Heavy bombers ...	—	275	8 hours.
Seaplanes	270	220	10 hours.

In suggesting the sizes and weights of engines to cover the range of aircraft mentioned above, Mr. Fedden thought that the new vintage of engines would require more time and money spent on their development than previously. It was, therefore, more important to try to keep down the number of types. He did not intend to attempt to cater for the smaller civil categories, because he considered they were quite a separate section. Mr. Fedden hoped to be able to cover the suggested range of aircraft by four sizes of engine: 750 h.p. for 820 lb., 1,150 h.p. for 1,250 lb., 1,550 h.p. for 1,550 lb., and 2,000 h.p. for 2,100 lb. These figures included standard equipment as per Air Ministry instruction E.124, issue 3.

Influence of Fuel

Mr. Fedden recalled that in his previous paper he placed fuel first in a suggested list of the most important subjects for research as affecting the future development of air-cooled engines. He felt that it was still the all-important governing factor. The position with regard to supplies of 100-octane fuel seemed a good deal more hopeful than it was eighteen months ago. During the period under review it was understood that there was little doubt that we should have 100-octane fuel or better as readily as we had 87-octane to-day. Mr. Fedden gathered that the supplies would probably be in the form of iso-octane, and quite likely it would be ready in quantities before the engine makers had developed new engines to make full use of it. From this fuel in properly designed engines he thought we might expect an increase in horse-power of 25 per cent. with a decrease in consumption of from 5 to 7 per cent. This should enable a consistent cruising consumption of 0.42 pints per b.h.p. hour at approximately 60 per cent. of the maximum power rating. This made the case for the compression-ignition engine even more difficult to substantiate than before. Although it would make the c.i. engine less valuable from a consumption point of view, from the aspect of the volume of fuel used, the price of the fuel would still be considerably in favour of the compression-ignition unit. Mr. Fedden leaned to the view that for long-range night bombers of moderate performance, as well as for civil aircraft, there was a great deal to be said for the compression-ignition engine in fairly large sizes and of not less than 1,000 cruising horse-power. It was impossible to take such a high specific output from a given swept volume from the compression-ignition engine as from the corresponding petrol engine, but it was practicable to take a higher percentage cruising output from a given size from the compression-ignition engine, and if we were to look to mechanically assisted or catapulted aircraft for the future, then the compression-ignition engine had a better chance of coming into its own.

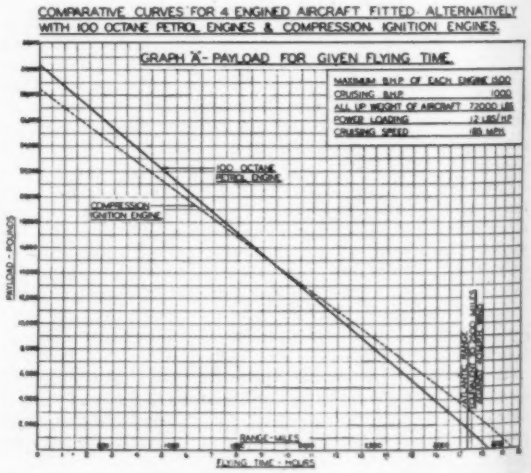
On looking into the possibilities of a compression-ignition engine as compared with a petrol engine on a comparative basis for 1,000 cruising horse-power, Mr. Fedden had obtained the following data:—

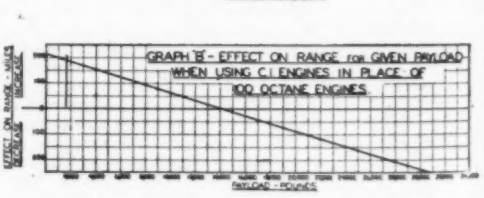
COMPARISON OF 1,500 B.H.P. AIR-COOLED RADIAL ENGINES: 100 OCTANE AND COMPRESSION-IGNITION.

	100 Octane Petrol Engine.	Compression Ignition Engine.
Horse-power at maximum r.p.m. and rated altitude (5,000 ft.)	1,500	1,500
Cruising b.h.p. at 66 per cent. max. power	1,000	1,000
Cruising Consumption — Lb. b.h.p./hour	0.435	0.38
Cruising Consumption — Pints b.h.p./hour	0.47	0.36
Cruising Consumption — Gallons hour	59.0	45.0
Net dry weight—lb.	1,620	2,100
Weight per b.h.p.—lb.	1.08	1.4
Fuel cost per hour, basic prices ... — (a) No transport charge	£7 7 6	£2 12 6
Fuel cost per hour, basic prices ... — (b) 1s. 6d. per gallon transport charge	£11 16 0	£6 0 0
100 octane fuel 2.6 per gallon; fuel oil 1.2 per gallon ... ... — (c) 2s. 6d. per gallon transport charge	£14 15 0	£8 5 0
Saving in fuel cost per hour — (a) No transport charge	—	£4 15 0
Saving in fuel cost per hour — (b) 1s. 6d. per gallon transport charge	—	£5 16 0
Saving in fuel cost per hour — (c) 2s. 6d. per gallon transport charge	—	£6 10 0

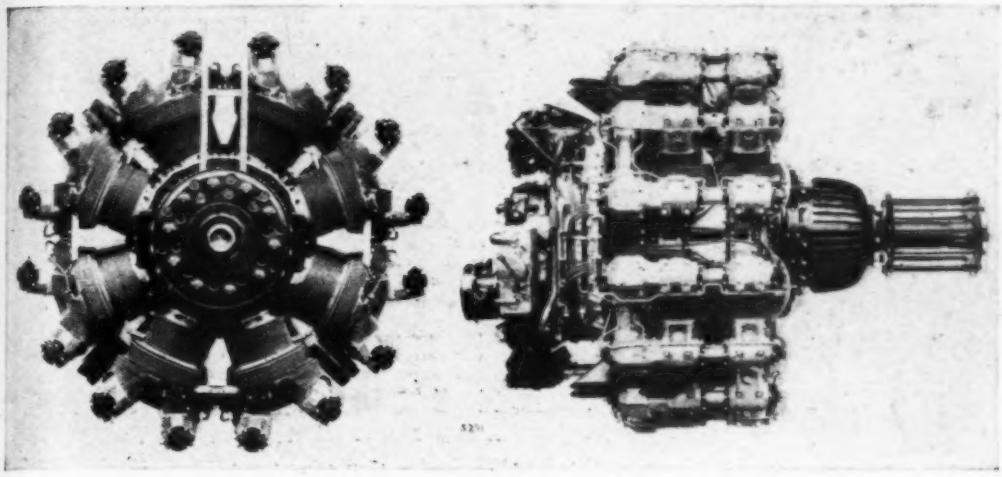
Mr. Fedden then went on to discuss the enthusiasm shown on the Continent for the compression-ignition engine and to speculate on the reason for this interest. He could raise no enthusiasm for theory of a ray to cut out the magneto of a spark-ignition engine, nor could he foresee any real difficulty in producing considerable quantities of petrol of a reasonably high octane value. He commented on the increased fire risk with 100-octane engines using much closer cowling and giving higher specific output.

Mr. Fedden much deplored the fact that greater energy was not being applied to the problem of the compression-ignition engine for aircraft in this country. He mentioned the official support which had been given to c.i. engine research, and explained that the progress of the petrol engine had been so rapid that up to the present the Bristol Co. had not deemed it advisable to carry their efforts beyond the embryo state. In his


COMPARATIVE CURVES FOR 4 ENGINED AIRCRAFT FITTED ALTERNATIVELY WITH 100 OCTANE PETROL ENGINES & COMPRESSION IGNITION ENGINES.
GRAPH 'A' - PAYLOAD FOR GIVEN FLYING TIME.
MAXIMUM B.H.P. OF EACH ENGINE 1500
CRUISING B.H.P. 1000
ALL UP WEIGHT OF AIRCRAFT 72000 LBS
POWER LOADING 12 LBS/H.P.
CRUISING SPEED 185 M.P.H.
100 OCTANE PETROL ENGINE
COMPRESSION IGNITION ENGINE
PAYLOAD - POUNDS
RANGE - MILES
FLYING TIME - HOURS


GRAPH 'B' - EFFECT ON RANGE FOR GIVEN PAYLOAD WHEN USING C.I. ENGINES IN PLACE OF 100 OCTANE ENGINES.
EFFECT ON RANGE - MILES DECREASE
PAYLOAD - POUNDS

Commercial operators may glean some interesting information from the above graphs.



A sixteen-cylinder double octagon engine of 1,570 cu. in. capacity produced by Bristols in 1931. On 87-octane fuel the output was 1,020 h.p. at 6,000 ft. giving a figure of 1.43 lb./h.p.

opinion the psychological moment had arrived for a sufficient sum of money to be set aside for the development of an engine in the third category (1,550 h.p.).

Layout from the Geometric Aspect

Many factors contributed to the design and form that aero-engines might take, including power, flying cost, weight, balance, firing order, distribution, fuel consumption, accessibility, and maintenance.

Considering data relating to engines at the last three Paris Shows, it was found there was a steady increase in the percentage of air-cooled engines and that the radial air-cooled type was holding its own. The percentage of engines between 500 h.p. and 750 h.p. had decreased, whilst an increase was shown in the 750 h.p. to 1,000 h.p. class and the 1,000 h.p. to 1,300 h.p. class.

It appeared that to employ cylinders of more than 5¾ inches to 6 inches bore introduced very serious problems. As we approached the higher power categories (viz., 2,000 h.p.) it was difficult to find a geometric layout, even with the largest size of cylinder, to give the required power and remain a reasonably simple production proposition.

For military purposes low first cost, ease of production, and speed of removal and installation were being given comparatively little attention. The Air Ministry expansion scheme had emphasised the vital necessity for such consideration.

On general principles the greater the number of cylinders per unit volume the greater was the weight, and the smaller the volume of engine the higher the specific output that might be expected. Graphs were shown to illustrate the lightest practical form of engine for any given h.p. and the effect of cylinder capacity and total volume of specific output.

Interesting light was shed upon the difficulty in producing a successful large-size aero-engine, weight considerations necessitating the largest bore and stroke permissible, the latter resulting in a lower rotational speed.

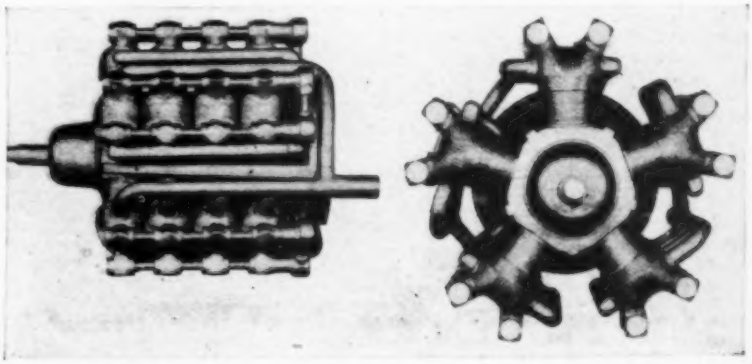
Slides were shown of a double-row sixteen-cylinder engine produced by the Bristol Company in 1931. This was designed to run at high speed and had overhead camshaft, but was abandoned, chiefly due to the Bristol Company's sleeve-valve development. It showed clearly, however, how easy it was to add weight with an increase in r.p.m. and a relatively large number of cylinders for a given swept volume. Other views were shown of a model of a 20-cylinder multi-bank radial of 1,000 h.p. with overhead camshaft, designed, but not actually built, by the Bristol Company for a similar type of high-speed, high-efficiency engine. It was noted that the power/weight ratio of this type of engine was also disappointing.

Discussing the Potez-Lorraine twelve-cylinder flat engine exhibited at the last Paris Show, Mr. Fedden explained that although this engine did not appear to have been designed for minimum depth, it was possibly an indication of the trend of future design for really high-speed aircraft of the smaller category. The weight, horse-power of ratio of this engine was surprisingly low. The Walter Sagitta twelve-cylinder inverted vee was a good representative type of the moderate power twelve-cylinder vee engine popular on the Continent. Its overall dimensions and the weight/horse-power showed the disadvantage of the in-line type in comparison with the radial. A silhouette of the proposed cowling for this engine emphasised the abnormal wetted surface of the type.

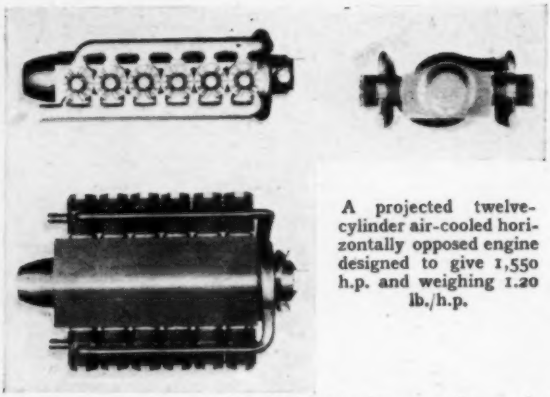
Slides were shown to illustrate that output per litre, often considered to be the all-important criterion of engine efficiency, could often be misleading. It was shown that power output per square inch of piston area was a more valuable guide to the actual output efficiency of an engine, as it was proportional to the product of mean pressure and piston speed. Piston speed was an important problem to explore when reviewing the geometric layout of engines, and although it was not a truly accurate measure of inertia pressures of either pistons or valve gear, nevertheless, it was the best criterion of mechanical and breathing difficulties due to velocity.

It appeared that to cover the four different categories of engine power suggested, the most promising layout would still be divided into two families—radial engines, as single and double bank; and in-line, multi-bank. It was suggested that the increased weight and cost of production of in-line engines would be sufficiently serious to militate against their introduction for the immediate future, except under special conditions.

It was agreed that balance and firing order were satisfactory on all the types considered, and that fuel consumption should



Showing the general appearance of a projected twenty-cylinder, five-bank radial of 1,005 cu. in. capacity, 40 in. diameter, 1,450 lb. weight and 1,000 h.p. output at 13,000 ft.



A projected twelve-cylinder air-cooled horizontally opposed engine designed to give 1,550 h.p. and weighing 1.20 lb./h.p.

be generally similar, tending to become lower as the number of cylinders increased, provided cooling technique was adequate. It should be possible to make distribution reasonably good on all the types considered, but it seemed clear from experience to favour the radial engine on this score in view of the shorter and more symmetrical pipes.

The main governing factors in aerodynamic layout were shape, overall size or wetted surface, and wing surface as a function of the complete nacelle, including the power plant. For the smallest and highest speed categories of military machines under consideration, Mr. Fedden suggested that a specialised type of engine would have to be produced.

Recent research work at the R.A.E. had shown that, for overall aerodynamic efficiency, there was little to choose between the best representative types of power plant, the variation of the relative drag contribution from different sources balancing out evenly.

The drag of a power unit could be broadly divided into three headings, (a) drag due to cooling air flow, (b) drag due to installation of a nacelle on a wing, and (c) drag equivalent of power plant weight.

Basically, Mr. Fedden explained, for any cooling system a certain weight of air per minute was required. So far as air-cooled engines were concerned this was a function of cylinder size, fin area, and power output. From this aspect, therefore, there were two distinctive types of layout: (1) The in-line, with a relatively large number of small cylinders which favoured a reduced mass flow (being the equivalent of an increase in radiator size) at the extent of a higher weight per brake horse power ratio; (2) the radial with fewer but relatively larger cylinders requiring a slight increase in mass flow but favouring the lowest weight per brake horse power ratio.

To illustrate the magnitude of the mass flow factor of radial engines, tests had been carried out on an unbaffled Pegasus type cylinder which showed that the cooling power loss only varied as power output raised to the 2.4th power. Since there was no indication that the limit of finning had been reached, this exponent might be reduced by improved technique and development of baffles.

In connection with the question of air density as affecting the rate of heat dissipation, it was explained that the fall in air temperature with altitude, up to the lower limits of the stratosphere, was more than sufficient to offset this effect, since the cooling power loss only varied inversely as the square of the density, whereas it varied inversely as no less than the ninth power of the temperature difference.

With increased speed of aircraft the adiabatic rise in temperature of the cooling air caused by slowing it down over the surface to be cooled was becoming a factor of considerable importance, since it varied as the square of the speed, and whilst being only 9 deg. C. at ground level at 300 m.p.h. it became 16 deg. C. at 400 m.p.h. and 25 deg. C. at 500 m.p.h. The high temperature of the cooling surfaces of the air-cooled engine, however, would cause it to be less affected by this consideration than other types.

Compressibility Effects

The effect of the compressibility of air on the performance of high-speed machines was becoming more serious, and for speeds in excess of 400 to 450 m.p.h. might present a new set of aircraft design problems. It had been demonstrated by Meredith of the R.A.E. that this effect was not wholly detrimental, it having been established that a ducted type of cooling system could function as a heat engine, the heat energy imparted to the air in cooling the energy being converted to an effective thrust by adiabatic expansion. The thrust obtained increased approximately as the square of the speed.

Apart from compressibility effects there was a further gain to be derived by utilising the kinetic energy of the exhaust gases by reaction in a rearward-facing exhaust pipe. Unfortunately, this gain only varied with the machine's speed, but even so it was more than sufficient to offset the losses due to change of momentum of air used for carburettor and oil cooling, which varied as the square of the speed, and still left a balance for effective thrust.

Dealing with the drag due to the installation of a nacelle on a wing, Mr. Fedden explained that nacelle form and drag were influenced by the shape of the engine, its overall length and weight. Two main problems were to be considered—the reduction of spoiling loss associated with duct entries and reduction of wetted surface. With regard to the former, the

ENGINE COMPARISON ON THE BASIS OF B.H.P./SQ.IN. PISTON AREA.

TYPE	CAPACITY (LITRES)	MAXIMUM RATING B.H.P	MAXIMUM RATING R.P.M.	B.H.P/LITRE CORRECTED TO SEA LEVEL	B.H.P/SQ.IN PISTON AREA CORRECTED TO SEA LEVEL	PISTON SPEED (FT/MIN)
AERO ENGINES						
BRISTOL PEGASUS XXII	28·7	1010	2600	35·2	4·32	3250
BRISTOL MERCURY VIII	24·8	840	2750	37·5	3·97	2980
ARMSTRONG SIDDELEY TIGER IX	32·7	880	2375	26·9	2·64	2375
NAPIER DAGGER III	16·8	805	4000	49·6	3·05	2500
ROLLS-ROYCE 'R' (SCHNEIDER TROPHY)	36·7	2785	3400	75·6	8·20	3450
PRATT & WHITNEY WASP 1830	30·0	1100	2650	36·7	3·30	2430
WRIGHT CYCLONE 'G'	29·8	1000	2250	33·6	3·77	2580
GNOME-RHÔNE 14N	38·6	1000	2400	28·4	3·02	2600
GNOME RHÔNE 14M	18·9	650	3000	37·7	2·82	2280
HISPANO-SUIZA 14AA-00	45·2	1000	2100	22·9	2·52	2340
RENAULT COUPE DEUTSCH 12V	8·0	450	4500	56·5	3·3	2650
AUTOMOBILE ENGINES						
AUSTIN RACING	·744	116	7600	155·8	6·54	3240
TALBOT 3·5 LITRE	3·377	123	4500	36·4	2·63	3310
FORD V8-85	3·62	85	3800	23·4	1·44	2370

NOTE:- IN THE CASE OF ENGINES RATED AT ALTITUDE THE CORRECTED B.H.P's WERE OBTAINED BY ADDING TO THE NETT B.H.P. THE POWER A BLOWER OF 50% OVERALL EFFICIENCY WOULD ABSORB TO RAISE THE MIXTURE FROM ATMOSPHERIC PRESSURE TO 14·7 LBS/SQ.IN.

EFFECT OF POWER PLANT WEIGHT & DIAMETER. COMPARATIVE PERFORMANCES OF TWIN ENGINED FIGHTERS.

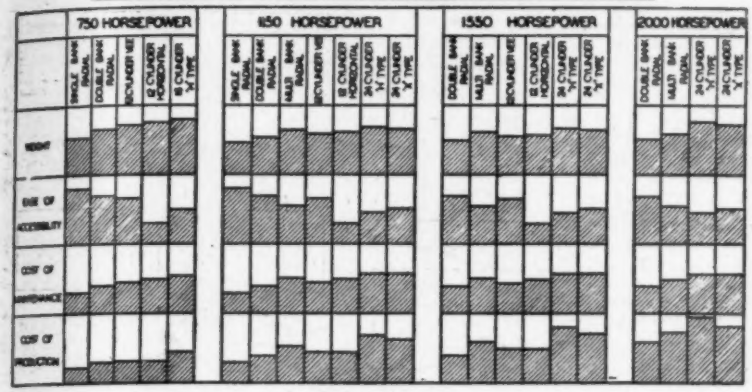
CASE I SINGLE ROW 9 CYLINDER ENGINE

CASE II DOUBLE ROW 14 CYLINDER ENGINE

ITEM	CASE I	CASE II
ENGINE DIAMETER	46·5"	40·0"
ENGINE POWER	750 H.P.	750 H.P.
ENGINE WEIGHTS (NETT DRY)	1640 lbs.	2000 lbs
POWER PLANT ACCESSORIES :- AIRSCREWS, EXHAUST SYSTEMS CONTROLLABLE COWLS, ENGINE MOUNTINGS NACELLE STRUCTURE, STARTING GEAR, OIL COOLERS, FUEL & OIL SYSTEMS, ENGINE CONTROLS & INSTRUMENTS, INTAKES, FILTERS & PUMPS WITH DRIVES.	1450 lbs.	1450 lbs
FUEL, OIL & TANKS (½ HRS.)	865 lbs	865 lbs
MILITARY LOAD	150 lbs	150 lbs
STRUCTURE WEIGHT	2183 lbs	2425 lbs
TOTAL WEIGHT	7315 lbs.	7890 lbs.
WING AREA	244 sq ft.	263 sq ft.
WING LOADING	30 lbs/sq ft.	30 lbs/sq ft.
POWER LOADING	9·75 lbs/HP	10·5 lbs/HP
TOP SPEED	375 m.p.h.	376 m.p.h.

On the left some of the world's foremost engines figure in a searching comparison. The second table makes out an excellent case for the single-row radial with its comparatively low weight.

RELATIVE MERITS OF VARIOUS AIR-COOLED ENGINE LAYOUTS.



A wealth of information is available at a glance from this chart.

equivalent conventional form of cowled radial engine appeared to suffer more than the in-line engine in this respect, a contributory factor being a boundary layer breakaway over the airscrew spinner which was the centre of the duct entry.

Tests carried out in N.A.C.A. wind tunnels on radial air-cooled installations showed that for a given nacelle-wing combination, the maximum propulsive efficiency was obtained with the airscrew located at 30 per cent. of the chord ahead of the leading edge, and tests in this country confirmed this for similar geometric arrangements. Research at the R.A.E. also showed that the radial engine nacelle drag was a function of the ratio of wing thickness to engine cowl diameter.

From a consideration of pitot entries in the leading edge of the wing, and provided the internal wing structure was arranged for duct cooling and accessibility, the drag due to spoiling loss and nacelle surfaces could be practically eliminated by the retraction of the radial engine within the leading edge on aircraft with wing thickness equal to the engine diameter. Existing test data indicated that if the airscrew were required to work within 10 per cent. of the chord its propulsive efficiency would not be appreciably affected. This arrangement would only be possible on aircraft of at least Short Empire boat size and proportion.

Fuselage interference effects and in many cases the housing of a mechanically retracting undercarriage needed careful consideration in deciding upon the design of a nacelle and its position in relation to the wing if the minimum drag was to be achieved. A compromise generally had to be made after consideration of all the factors involved. Research as has been carried out on full-scale installations to date indicated a form drag with nacelles irrespective of the type of engine enclosed, and by the reduction of this drag in common with the development of the technique of surface finish there was an appreciable gain to be derived. Until a series of full-scale tests was carried out it would be impossible to assess with complete accuracy the relative drag cost of representative power units mounted on a wing.

There was some evidence to show that on a radial air-cooled engine an improvement was to be obtained by deleting the conventional controllable gill exit and ducting the cooling air to the trailing edge of the wing. A controllable flap at the exit would be required to induce flow through the duct for engine running on the ground and in climbing flight. The passage areas were arranged in a representative double-row installation so that the air velocity did not exceed 100 m.p.h.

In discussing the drag equivalent of power plant weight Mr. Fedden recalled that he had already endeavoured to outline the main characteristics affecting engine weight and its effect on simplicity, maintenance and prime cost of the power plant, but maintained that weight must also be reviewed from the aerodynamic aspect as producing an additional drag equivalent of the complete power plant. The relationship between the wing thickness and cowl diameter, he recalled, influenced the nacelle drag and with increased wing thicknesses the rate of gain would favour the radial, since the improvement was largely associated with the reduction of duct entry loss. Probably with this point in mind, small-diameter double-row radials have been developed for high-speed twin-engined military types and were common at the last Paris show. He had given some thought to this development and had explored the merits of the two-row radial with the single bank in this category with regard to mechanical layout, weight and cost.

Capt. Barnwell had examined the comparative performance of two twin-engined single-seater fighters having double-bank and single-bank radial engines respectively, and for the purpose of comparison the wing loading of the two aircraft was constant so that the landing speeds were the same. It was seen by figures provided that the top speeds of the two machines were approximately equal, the drag of the increased wing surface, due to the extra weight of the small double-row engine, offsetting the increased nacelle drag of the larger but lighter single-row type. Mr. Fedden thought it would be fair to state that on comparable aircraft designed around radial and in-line engines, little advantage could be claimed by either in regard to the relative wetted surface and overall drag. There did not appear to be any appreciable advantage with any one type of engine layout, so that the final verdict would have to be obtained from the consideration of other qualities, such as first cost, production in time of emergency, installation simplicity, ease of maintenance and repair and fuel consumption. Mr. Fedden thought that low power/weight ratio would also be of fundamental importance and it appeared that the only justification for departing from this characteristic would be the introduction of specialised engines completely buried inside the wing.

Standardisation of Complete Power Units

The standardisation of all aircraft components was one of the most pressing needs of the industry to-day. Progress has been achieved along lines which facilitated standardisation due to the localisation of power units on monoplane wings. Not only would there be a saving in time and cost of the design staff, together with the simplification of stores equipment, but by the use of the standardised power unit a saving in time during which an aircraft would be out of commission when it was necessary to change engines.

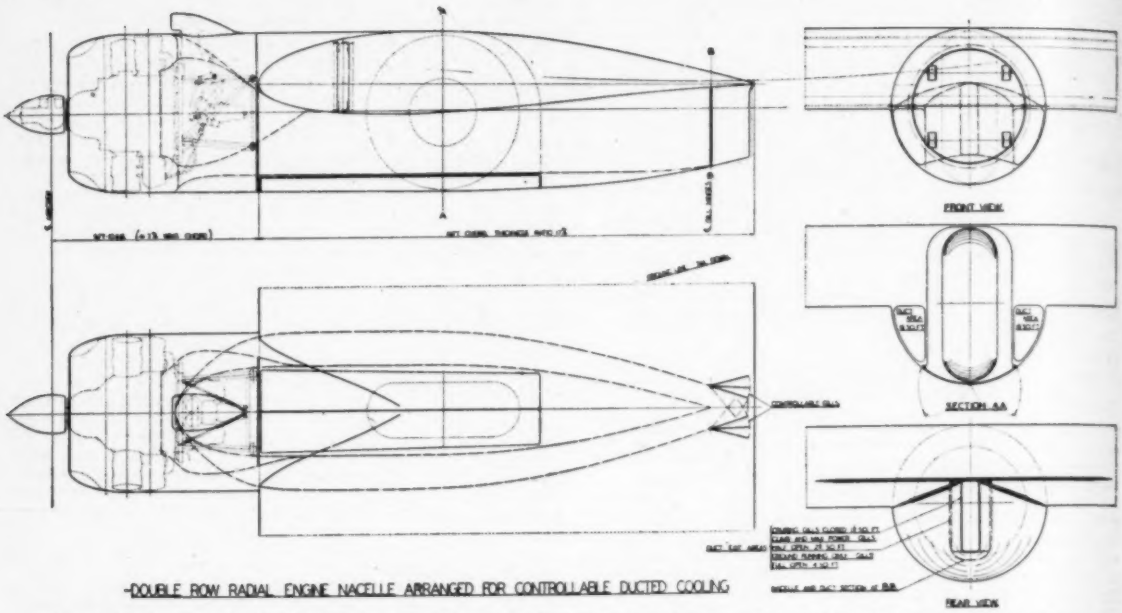
Air-cooled power plants generally and particularly air-cooled radials were especially suited to standardised unit construction.

In a typical modern installation, the exhaust system, the removable cowling and controllable gills were standardised units built into the aircraft by the aircraft constructor in collaboration with the engine manufacturer. This was only the commencement of what could be accomplished now that modern aircraft were stabilised into a more concrete series, and it was suggested that the scope should be considerably extended, the engine constructor providing a quickly removable engine mounting plate together with a standardised frame structure between it and the fireproof bulkhead. Within this space a number of engine components would be installed in a manner best suited for their proper functioning, accessibility and to facilitate easy power unit removal.

All multi-engined aircraft would have their power units in nacelles mounted centrally or dropped relative to the wing according to design requirements. Wing chords would vary with different designs.

Installations employing conventional controllable gills, should be arranged so that the gill exit had a reasonable clearance ahead of the leading edge. The engine could be located near to the wing when ducted installations were used, and although a standard mounting structure was not incompatible between the two systems, the latter might restrict the disposition of attachment points on the normal fireproof bulkhead line.

The principal dimensions and anchorage points must be common to all of these alternative arrangements, viz. (1) the distance between the normal bulkhead and the engine; (2) the four attachment points on the plane of the bulkhead. The following design considerations would decide the position of these four points: (a) the type of construction and form of the after body nacelle—monocoque or strut-braced; (b) undercarriage and wheel housing; (c) oil tank and oil cooler installation; and (d) provision of sufficient space for cooling air flow in the case of the completely ducted installation.



A probable future trend in radial-engine installation is indicated by these drawings of a controllable ducted cooling system.

It was suggested that the engine mounting might consist of a triangulated tubular structure attached to four standardised and accurately jigged structural points on the bulkhead. These joints could be conveniently arranged for a ball-ended spherical housing. The front end of the structure would be finished by four bolt-ended sockets to which a quickly detachable engine plate could be mounted. The engine would be attached to this plate in the normal manner. This apparent duplication would serve a dual purpose in that the complete mounting with accessories could be standardised for production, but in certain cases operators would have the option of detaching the engine complete with mounting plate if they did not wish to carry duplicate structures, oil tanks, etc.

The complete unit should include provision for the following services and accesssories which could be divided into six groups: (1) An auxiliary which might be driven through the single drive remote gear box: electric generator, high-pressure air compressor, low-pressure air compressor, high-pressure fluid pump, vacuum pump. (2) Units which might be located on and detached with the engine mounting: oil tank, oil cooler, oil cleaner, starter magneto, exhaust gas analyser, fire extinguishing system.

With this arrangement of engine and auxiliary units the number and type of connections which must be broken to permit removal of the power plant could also be divided into groups. (3) Electrical connections : engine starter lead; ignition lead; thimble couple lead; oil thermometer lead; exhaust gas analyser leads. (4) Hydraulic or union connections; Petrol feed (to and from engine-driven pump); oil pressure gauge; boost gauge; fire extinguishing system. (5) Mechanical connections: Carburettor hot air intake control; carburettor slow running cut-out control; oil cooler air intake control; variable pitch airscrew control. (6) Other connections with alternatve methods of operation : Throttle and mixture controls—mechanical or hydraulic; tachometer—mechanical coupling or electrical; variable cowling gill control—mechanical or electrical.

It was unlikely to be possible to have only one standardised power unit for each type of engine, but it was hoped that it might be possible to limit the number to two.

Concluding his paper, Mr. Fedden endeavoured to sum up the most promising layout for the four sizes of engine he had mentioned. It appeared to him that the general trend would be to submerge power units within the envelope of the wing. A complete change-over of all four categories of engine was out of the question in the period under review and would most probably never be required, since in the larger classes where four or more engines would be standardised on one aircraft the wing thickness would be such as to permit of the radial engines being housed inside the leading edge.

The placing of the engine inside the wing envelope would, in Mr. Fedden's opinion, first come into being in the smallest engine category.

The first category—750 h.p. for 820lb.—Mr. Fedden thought would be suitable for twin-engined civil and military aircraft. He suggested that this size of engine was suited to the twin-engined destroyer of multi-engined fighter type, and in the period under review he thought there was justification for serious consideration of the flat engine entirely buried in the envelope of the wing for these types of aircraft. About eighteen months ago the Bristol Co. produced a layout for such an engine, but urgency of other work and the need for an entirely new technique of aircraft design, prevented it receiving very serious consideration. Provided a sufficiently bold and specialised step could be justified for military purposes for the highest speed, it was believed that this was the ideal solution for the future for the smallest category of engines, and

INSTALLATION DRAG OF RADIAL v IN LINE AIR COOLED ENGINES

	RADIAL	IN LINE
MAXIMUM POWER (100 OCTANE)	800 HP	800 HP
WEIGHT - NETT DRY	850 LB	1175 LB
	DRAG AT 100 FT PER SEC	
TOTAL INTERNAL COOLING DRAG	1·5 LB	·5 LB
NACELLE DRAG	7 LB	7 LB
DRAG DUE TO DIFFERENCE IN POWER PLANT WEIGHT (WING LOADING 25LB SQ FT)	–	1 LB
TOTAL	8·5 LB	8·5 LB

The effect of the greater weight of the in-line unit is clearly demonstrated here.

apart from the fact that the engine drag approached the ideal solution an aircraft so equipped had many other advantages. It was suggested that the radial engine was the ideal form in this category for small general purpose and civil types.

Sacrifices in regard to weight, cost, simplicity, etc., would all have to be made on account of the flat engine, and many problems with regard to installation carefully investigated.

For the other three categories of engine (1,150 for 1,250 lb., 1,550 h.p. for 1,550 lb., and 2,000 h.p. for 2,100 lb.) Mr. Fedden firmly believed that the radial engine would hold its own during the period under review.

It would be useful if some advice could be given as to the trend of wing thickness for the future, as it seemed that this might have a considerable bearing on engine layout.

To sum up, during the next five years it appeared that the smaller the size of the aircraft the more difficult it would be to obtain a suitably scaled radial or in-line engine of sufficient power, while the larger the size of the aircraft the less it seemed could be said against the radial; in fact, in the largest category the engine was almost entirely lost in the section of the wing.

The wetted surface of a ducted radial engine of this size must be a very small proportion of the total wetted surface of the aircraft. Such engines would be required for a large civil flying boat or long-range bomber cruising at 250 to 275 m.p.h.

It was believed that every engine designer was anxious to learn all he could before finalising his new series of engines for 100-octane fuel.

THE DISCUSSION

MR. F. R. BANKS, of the Ethyl Export Corporation, thought Mr. Fedden had been rather conservative in quoting a cruising consumption of 0.435 lb./h.p./hr. for the 100-octane petrol engine, and expressed the view that with development it ought to be possible to reduce that figure to about 0.38 lb./h.p./hr. Mr. Fedden had mentioned that up to the lower limits of the stratosphere the fall in air temperature with height was more than sufficient to offset the effect of cooling due to lower density. He (Mr. Banks) had been reading an article by Mr. C. F. Taylor, of the Massachusetts Institute of Technology, in the January, 1937, issue of the "Journal of the Aeronautical Sciences," the conclusions of which did not seem to agree with Mr. Fedden's. The American writer found that both on account of the high temperature of the hotter portions of the cylinder and because of the difficulty of extending the fin area, the air-cooled was at a disadvantage at the higher altitudes. Liquid cooling, on the other hand, could be extended simply by increasing the radiator surface. Mr. Taylor came to the conclusion that if and when stratosphere-flying arrived, liquid-cooled engines were likely to be used.

MAJOR F. M. GREEN thought one of the most remarkable things shown by the paper was the very low cooling drag achieved with modern air-cooled engine installations. He did not agree with the lecturer that full-scale flying was the way to do research on further engine problems, and thought the most logical place for such research was the large wind tunnel at Farnborough.

MAJOR R. H. MAYO paid a tribute to Mr. Fedden and the Bristol Company for their share in the success of the Empire flying boats. His announcement of the non-stop flight of the Caledonia from Calshot to Alexandria that day was greeted by the audience with applause. He welcomed Mr. Fedden's remarks about the C.I. engine and said that operators were certainly interested, but no suitable engines had yet been available. The civil aviation market was far too small to be in a position to pay for development, and the Government ought to support a compression-ignition programme. Among diesel advantages not mentioned by the lecturer were the saving in maintenance afforded by the absence of ignition equipment, and he also thought the pilot's controls would be more easily maintained at the right cruising mixture. He would like to know Mr. Fedden's reasons for suggesting that the diesel engine was only useful in very large sizes.

MR ALAN CHORLTON, M.P., was disappointed with the small progress made with the compression-ignition engine. He realised that the introduction of the new petrol fuels was responsible, but thought it still worth while to push along with development. He had tried, but with no great success. If the R.Ae.S. were to *demand* diesel engine development he thought we should get it.

MR. C. P. LIPSCOMB, assistant chief designer to Short Brothers, apparently agreed with the views expressed in *Flight* last week. He was frightened by the idea of eight engines spread along the leading edge of a wing. Apart from the effect of engines close towards the wing tips, what would be the spoiling effect of so many engines on the efficiency of the wing? If, on the other hand, single large engine units were to be introduced, they would run into trouble with airscrew noise owing to high tip speeds. He estimated that an airscrew for a 2,000 h.p. engine in a machine cruising at 200 m.p.h. would need to be of about 17 ft. diameter. This seemed to indicate the need for two-speed gears. He thought the difficulty with C.I. engines was that of providing enough power for take-off.

MONSIEUR R. MÉNÉTRIER, the designer of the Potez flat-twelve engine shown at the last Paris show, explained that the Potez engine was developed after a thorough study of all types. Its drag was low and accessibility good. The low weight was due to the short stroke and to a very light crankcase, made possible by using through-bolts to hold the cylinder heads together. On a single-cylinder unit running on 100 octane fuel, adequate cooling was secured with 7.5 grammes of air per horse-power per second.

MAJOR B. C. CARTER, of the Royal Aircraft Establishment, made the interesting observation that if two engines of identical geometry were built their weights would vary in direct proportion to the size. Thus if one took one of Mr. Fedden's engines and scaled it down to half size, doubling the speed, one should get an engine weighing about 0.5 lb./h.p.

MONSIEUR PONTREMOLI, chief engineer of the aero department of the Alvis Car Co., mentioned the possibility of using smaller airscrews running at tip speed greater than the speed of sound. This would necessitate new airscrew designs. He also put in a good word for the engine of 300-400 h.p., expressing the view that two of these engines would probably supersede the old type with a single engine of about 500 h.p. He did not see the immediate need for the 2,000 h.p. engine, nor did he agree with the need, at present, for 100 octane fuel. He agreed with Major Mayo that the small diesel was interesting. He would like to see a date announced after which no petrol engine would be allowed to be used in civil aircraft. He was, unlike Mr. Fedden, in favour of the smallest possible diameter of radial engine, but he agreed that if the in-line air-cooled had a market it would be of the flat and not of the vee type.

MR. S. EVANS expressed alarm at the weight figures given by Mr. Fedden for two-row radials. The American Pratt and Whitney engines of this type were not nearly so heavy. He also asked for information about airscrews close to the leading edge.

Mr. Fedden's Reply

MR. FEDDEN, replying to Mr. Banks' criticism that he had been a little unfair to the 100-octane petrol engine, said he had given a figure of 0.43 lb./b.h.p./hr. because his figures were based on the high cruising power of 66 per cent. of the maximum power (not 66 per cent. of the normal power), and that was a good deal higher than they were accustomed to use in air-liner work.

With regard to the effect of air density on cooling, he said he had seen the paper by Mr. Taylor on "The Next Five Years in Spark-Ignition Aviation Engines," and he felt that the only answer to Mr. Banks was that if one got busy with figures on certain results one could "make the punishment fit the crime" in any way one chose. His Company had had some experience of high-altitude flying during the last twelve months, and, contrary to their expectations, they had not experienced any trouble at all with temperatures at altitudes of about 50,000 ft. He assumed that, at any rate for regular long-distance flying, a long time would elapse before machines operated at above about 30,000 ft.

The Rolls-Royce Company and the Bristol Company had done some quite serious work on compression-ignition and had achieved a certain amount of success. But, speaking for the Bristol Company, he said they had always had to make compression-ignition the third or fourth priority; those who were trying to do research or development work on the compression-ignition engine never had sufficient time to devote to that work, for they were frequently called upon to turn their attention to some trouble which had arisen in production or to some other problem. The petrol engine had been a terribly spoiled child of late years, and everything had been given to it. The research on petrol and on fuels generally had given the petrol engine such an advantage that the compression-ignition development would not be conducted with the real drive that was needed to give it a chance to come into the picture, unless it were done by someone having no interest at all in anything other than making that particular design work or getting the sack.

Welcoming Major Mayo's remarks, Mr. Fedden said that the Bristol Company valued tremendously the information derived from the use of their engines by Imperial Airways, and the development resulting therefrom. Imperial Airways were hard taskmasters, and the Bristol Company had to watch their step when they put on to an Imperial Airways' service an engine which had been developed for military purposes. Quite frankly, there were no civil engines of the big type to-day. The big engines were always military engines, and when the Bristol Company had done the work they had to do for the Air Ministry and had obtained good results from their engines in military service, Major Mayo and his engineers usually found some trouble! Nevertheless, the use of the engines by Imperial Airways was of great value.

Dealing with the question as to why he felt that the compression-ignition engine had a better chance to compete with the petrol engine in the larger than in the smaller sizes, he said there were three main reasons. In the first place, the measurement of a very small quantity of fuel was a difficult problem, and, therefore, he would not like to have to think of getting reasonable combustion in cylinders of less than about 5 in. bore, judging by the Bristol Company's experience Secondly, it was more difficult to compete in respect of weight in the smaller sizes than in the larger sizes, because, owing to scantlings, more weight had to be used to deal with the higher explosion pressure of the compression-ignition engine. Thirdly, owing to the more severe torque of the compression-ignition engine for a given power, it was necessary to provide more cylinders.

The Five-year Period

Commenting on Mr. Chorlton's query as to why the period of prophecy covered by the paper was limited to five years, Mr. Fedden said that, as a matter of fact, he *had* been invited to visit a Russian aero-engine factory at which, he was told, one thousand draughtsmen were employed, and he was hoping to go. However, prophecy was frightfully rash, and probably he had chosen the period of five years because he might have made a bigger ass of himself by attempting to prophesy over a period of more than five years.

Dealing with the question as to why the compression-ignition engine had not come to the front before now, he said that so long as people persisted in the attitude that compression-ignition engines would be used as soon as they were equal to the petrol engine in respect of weight, we should never use them. He was not satisfied to hear designers say that they had no objection to the compression-ignition engine, but he wanted them to feel, as he did, that in certain categories of aircraft the advantages of the compression-ignition type of engine were so great that they were prepared to give away something in favour of it while it was feeling its feet. If they would be patient for a few years and give it a chance to feel its feet, he was certain they would be very surprised and pleased by some of its characteristics.

Replying to Mr. Lipscomb, he said he was hoping to secure advice on the subject of the number of engines that could be used on the leading edge of a wing; it was desirable to reduce the size of the power unit as much as possible. In view of Mr. Lipscomb's remarks concerning the propeller problem it seemed that we must meet it by means such as a two-speed gear or concentric propellers. He felt that the assisted take-off type of aircraft offered the compression-ignition engine the best chance of making good, because that engine was rather less sensitive to rich mixture and overboosting than was the high-octane petrol engine, but, nevertheless, it could be cruised at nearer its normal output.

When he had chosen the Potez engine for illustration as one of the most interesting engines shown at the Paris Salon he had no idea that M. Ménétrier, the designer of it, would have done the meeting the honour of attending. He appreciated very much the fact that M. Ménétrier had attended, and the interesting information he had given.

The question with regard to scaling-down had been put to him frequently by Major Carter, but he had always failed to answer it. All that he could tell Major Carter was that the tabulations he had made were honest and genuine, having been taken from all the data he could find. Further than that, he must struggle out of the argument as best he could by pointing out that it was not quite fair to scale down an engine in size and weight exactly, for the carburettors, magnetos and plugs, for example, weighed the same whatever the size of the engine.

Mr. Fedden agreed with M. Pontremoli that progress had been made in increasing the power developed by engines of given size during the last few years, and that we should make more progress. He did not agree, however, that we should not use 100-octane or even 130-octane fuel, at any rate for military machines, if the fuel suppliers provided such fuel. If we could obtain 1,000 h.p. from an engine of 3 ft. size fitted inside a wing, it would be worth doing for the super-military machine, no matter what it cost.

With regard to Mr. Evans's remarks concerning propellers being located at 30 per cent. and 50 per cent. of the chord ahead of the leading edge of the wing, he believed that research work at the Royal Aircraft Establishment had shown that 30 per cent. ahead was the most efficient position for a normal wing when using a radial engine. Nevertheless, long distances were used for the purposes of balance and for convenient housing of the undercarriage, and his Company had certain machines in course of construction, with their new engines, in which they were going as far as 45, 47, and even 48 per cent., in an endeavour to reduce the general overall drag of the radial nacelle. When he had referred to 10 per cent. in the paper he had visualised using engines buried inside the wing. He had nothing up his sleeve about that, but he hoped that somebody else had, because if the flat engine were as important as he believed it to be for the fighter aircraft, much would depend upon whether or not the propeller could be located as near as 10-15 per cent. of the chord in front of the wing without loss of efficiency and without giving rise to trouble with the engine or the wing.

Dealing with the comments on his statement about engines buried in the wing necessitating the use of propeller shafts, he said that in the design which he had suggested he would not propose using a separate shaft; but he did not think it was impossible to use propeller shafts successfully.

Replying to the adverse comments made with regard to the double-row radial of 1931, Mr. Fedden said he had illustrated that engine in order to emphasise that we could not afford too many cylinders for a given volume.

I.C.I. Alloys

TO meet the increasing demand, particularly from aircraft manufacturers, I.C.I. Metals, Ltd. (a subsidiary of Imperial Chemical Industries) are entering the aluminium alloy field. They are on the Air Ministry list, and their material—sheet and strip—complies with B.S.I. and D.T.D. specifications.

High-tensile Brasses

"HIGH-TENSILE brasses are of considerable engineering importance, and are widely employed in both cast and fabricated conditions. Although the use of fabricated high-tensile brasses in extruded or rolled rod and section forms is very extensive, the high-tensile brass alloys are far more frequently encountered in the form of castings, which may range in size from quite small products up to marine propeller castings weighting 50 tons or more. The widespread adoption of high-tensile brasses for general casting purposes is largely due to the facility with which they may be cast into complex shapes coupled with the very satisfactory strengths which are obtainable; indeed it is doubtful if such consistently uniform results can be obtained with any other alloys, as the ratio or strength in the cast conditions compared with strength after forging or other working treatment is unusually high. By selection of suitable composition, tensile strengths slightly exceeding 50 tons/sq. in. in the cast condition can be obtained, although alloys giving a strength of about 40 tons/sq. in. are generally preferred as they possess better ductility. Such brasses are often referred to as manganese bronze, although this expression, like many others used in metallurgical parlance, is a misnomer."

This is an extract from "High-tensile-strength Brasses—a Metallurgical Review of their Properties and Uses," a most informative booklet issued by the Copper Development Association. Copies are obtainable from the Association at Thames House, Millbank, London, S.W.1.

Edgar Allen Laboratories Extended

INCREASED pressure of work has necessitated extensions to the general laboratory of Edgar Allen and Co., Ltd., the Sheffield steelmakers. These extensions include an enlarged and beautifully tiled and equipped balance room, increased space for carrying out of analyses, and additional office and cloakroom accommodation.